A GENETICO-ENVIRONMENTAL STUDY OF THE MUSLIMS OF GOALPARA DISTRICT (ASSAM)

DISSERTATION

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DEDICATED TO HIS

DAUGHTER "PARISA"

& SON "IRFAN"

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CERTIFICATE

This is to certify that the work in connection with this dissertation entitled "A GENETICO-ENVIRONMENTAL STUDY OF THE MUSLIMS OF GOALPARA DISTRICT (ASSAM)" was carried out by A.T.M. Forhad Alx in this department under my guidance and supervision. The techniques and observations embodied in this work have been undertaken by the candidate himself and checked by me at every stage. This original work is suitable for the award of the Degree of Master of Philosophy of the Aligarh Muslim University, Aligarh.

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INTRODUCTION

INTRODUCTION

The nature and extent of genetic variation in Man is one of the central problems in modern human biology: Morphometric characteristics can be used readily to define difference between human groups and obviously have a genetic basis, but except in a few instances the exact manner of genetic control of such characteristics is not known. Further, their manifestation is often confounded by interaction with environmental factors. It is now realized increasingly that genetic resemblance in human population is not always indicative of a common descent and conversely, population with common descent may show genetic diversity. This realization seems to take into account a greater role of environment as a modifying factor on the genetic constitution of population through natural and social selection. Obviously, when natural selection can bring about great genetic diversity in a population spread over different environments, it can also at the same time smooth out genetic differences in populations of diverse origin, which live in the same environmental condition for a long period.

In a vast territory like India, for instance, where human populations live in all possible geographical environments from arctic to tropic, deserts to forests, on plains and at high altitudes -geography could form the largest single factor responsible for the genetic diversity of the people. Thus judgement, concerning of genetic

relationship among population on the basis of allele frequencies of ABO and PTC and reproductive potentiality of a population should be viewed in the light of their environment.

The present dissertation reports the frequencies of two genetic traits - ABO blood group and the ability to taste phenylthiocarbamide (PTC) and the genetic potential of the reproductive behaviour and fertility pattern among the muslims of Goalpara (Assam). For the present study the muslim are divided into two groups - rural and urban with the assumption that they are distinctly separated from each other ethnohistorically, socio-culturally and so to say linguistically, although both these groups constitute the large Assamese Muslims. Both Muslim groups comes under Sunni sect. of Islam. The main reason for undertaking this survey is two folds.

Firstly, the investigator himself belongs to the same community which enabled him to carry out the investigation successfully.

Secondly, there exists absolutely no data on reproductive behaviour, while the only set of data available on ABO and PTC is inadequate being present in one sex only. There was thus an urgent need of a more comprehensive studies with respect to above mentioned traits of this region.

ABO Blood Group:

Landsteiner, in 1900, carefully analysed the pattern of agglutination reactions between the cells and plasma of various individuals. Excellent summaries have been published by Race and Sanger (1968); Wiener (1961) and Giblett (1969), all of whom are in the forefront of workers in immunogenetics. The original classification of four blood groups, O,A,B and AB was based on the presence of blood group substance A or B on red cells. The cells are classed in group A if they are agglutinated by anti-A antisera, in group B if they are agglutinated by anti-B antisera and in group O if they lack both antigen A and antigen B and are not agglutinated by both anti-A and anti-B antisera. Red cells are classified as AB if they are agglutinated by both anti A and anti B antibodies. Both the antigens and antibodies of the ABO system are present from an early stage of foetal life and apparently do not change thereafter. The agglutigen reactions observed in ABO blood group system are summarized below:

Blood Group	Types of Antibody produced	Types of Red blood cells agglutinated	Transfusion accepted from
A	Anti-B	B,AB	Type A, Type O
B	Anti-A	A,AB	Type A, Type B
AB	None	None	Any donor
O	Anti-A and Anti-B	A,B, and AB	Type O only

The pattern of reactions of red cells and serum leads to the hypothesis that the ABO blood groups are determined by three alleles, two of them A and B dominant to a trait O but not dominant to each other. These facts are significant in studies of human genetics because the blood groups are inherited.

The pedegree analysis clearly show that in either the homozygous or heterozygous state, an individual possesses any two of the series of multiple alleles. The antigens involved are known as isoagglutinogens and are designated as I^A and I^B and i. The dominance relationships of these three alleles may be represented as $(I^A = I^B) > i$. Additional studies show that sub group I^A may occur in atleast four allelic forms. These are symbolized as I^{A1}, I^{A2}, I^{A3} and I^{A4}. A_1 is dominant to all other I^A alleles I^A2 ricessive to I^{A1}, but dominant to other and so on. Considering four forms of I^A, one of I^B and one of i, dominance within the series may be represented as:-

$$[(I^{A1} > I^{A2} > I^{A3} > I^{A4}) = I^B] > i$$

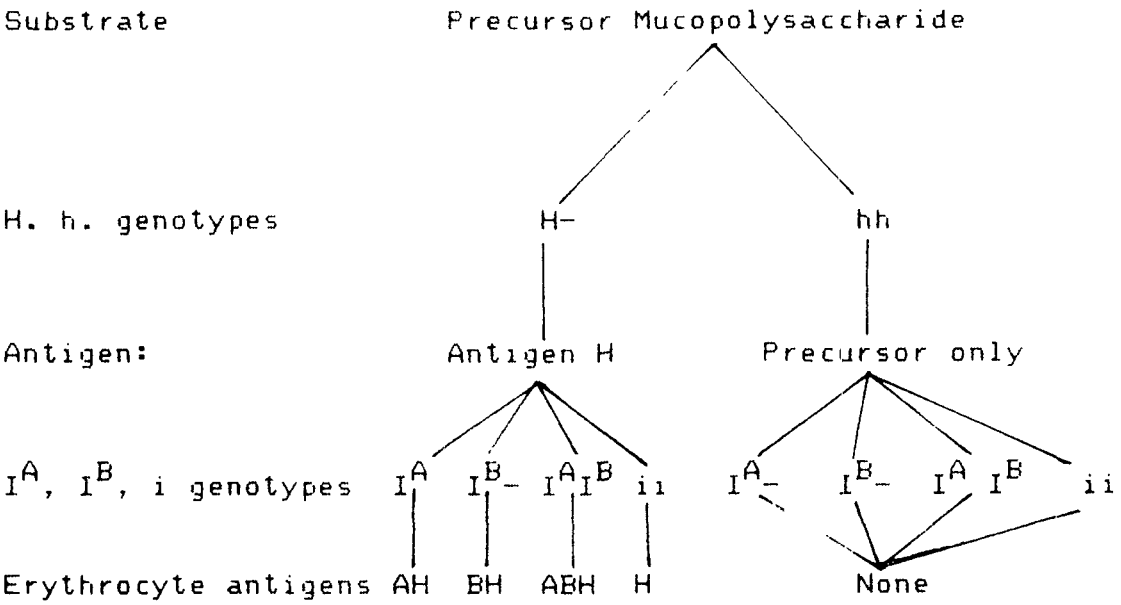
The genotypes and phenotypes of different blood groups of ABO system are represented below

Genotype	Phenotype	Genotype	Phenotype
I^{A1}, I^{A1}	A_1	I^{A3} I^{A3}	A_3
I^{A1}, I^{A2}		I^{A3} i	

I^{A1}, I^{A3}		I^{A1} I^{B}	A1 B
I^{A1}, i		I^{A2} I^{B}	A2 B
I^{A2}, I^{A2}	A_2	I^{A3} I^{B}	A_3 B
I^{A2}, I^{A3}		I^{B} I^{B} I^{B} i	B
I^{A2} i		ii	O

Bhende et al (1952) discovered a phenotype, which they called "Bombay". The erythrocytes were not agglutinated either by anti-A or anti-B or Anti-H. The serum contained all three agglutinins. Later, another family was discovered showing that the bearers of these unusual phenotype do have normal ABO alleles, but their manifestation is suppressed. The explanation of this is that antigen A and B are synthesized from a precursor mucopolysaccharide in the presence of the dominant allele of another pair designated as H and h with genotype HH or Hh, the precursor is converted to an H antigen, which in turn in the presence of I^{A} and I^{B} is partly converted to antigens A and B (Burns 1983). Therefore, in absence of genotype H -, A person can not produce antigen A and H, B person to antigen B and H AB to A,B and H. and consequently not react with anti-A, anti-B and anti-H. The Bombay phenotypes therefore exhibit O phenotype. Depending upon the nature of suppressed allele, the phenotype is designated as O_hA1, O_hA2 or O_hB (Vogel and Motulsky 1982).

The production of antigen in red blood cells in outlined below:



A comparison of two theories on the inheritance of ABO blood groups is represented below (Source: Stern, 1973):

Groups of parents	Groups of children expected according to	
	Two loci	multiple allele
1. O X O	O	O
2. O x A	O,A	O,A
3. O x B	O,B	O,B
4. A x A	O,A	O,A
5. A x B	O,A,B,AB	O,A,B,AB
6. B x B	O,B	O,B
7. O x AB	(O),A,B,(AB)	A,B
8. A x AB	(O), A,B, AB	A,B,AB
9. B x AB	(O) A,B, AB	A,B, AB,
10.AB x AB	(O) A,B, AB	A,B, AB

A more formal test of the hypothesis involves comparing the actual (observed) frequencies of the genes for the ABO blood groups with the frequencies expected if there are three alleles in the system. A population in Hardy – Weinberg equilibrium, if p is the frequency of gene A, q for frequency of gene B and r the frequency O, then P + q + r = 1.

Bernstein (1925) has shown that this relationship is satisfied within the limits of error imposed by the sample. In order to show this, estimate of the gene frequencies must be made from the frequencies of phenotypes in a population since a direct count of the three alleles is not possible. Genotype I^A_1 is classed as phenotype A and genotype I^B_1 as B in the serological test.

These estimates are made using the formulae is given below. In all the cases tested, the frequencies of the three alleles support the following relationship.

$$p = 1 - \sqrt{\bar{B} + \bar{O}}$$

$$q = 1 - \sqrt{\bar{A} + \bar{O}}$$

$$r = \sqrt{\bar{O}} \qquad \text{and } P + q + r = 1$$

where,

p = frequency of genotype A $\bar{A}$ = frequency of phenotypes A

q = frequency of genotype B $\bar{B}$ = frequency of phenotype B

r = frequency of genotype O. $\bar{O}$ = frequency of phenotype O.

Having proved the inadequacy of the locus hypothesis, Bernstein (1925) assumed the existence of three multiple alleles, best called I^A, I^B and i. As stated earlier, I^A and I^B are codominant if combined in the genotype, I^A I^B, but either allele is dominant in heterozygous combination with i. The frequencies of six possible genotypes based on three allelic system can be calculated as described below.

		Probabilities	
Blood Groups	Genotype	Genotype	Sum of appropriate genotypes
O	ii	r^2	r^2
A	I^A I^A	p^2	p^2 + 2 pr.
	I^A i	2 pr	
B	I^B I^B	q^2	q^2 + 2 qr.
	I^B i	2 qr	
AB	I^A I^B	2 pq	2 pq

The frequencies p, q and r which were assigned to the three alleles, must add upto 1 Thus p+q+r = 1.

The formulae just described enable us to express the allele frequencies p,q, and r in terms of observed frequencies of blood groups. Since the frequency of O individuals is r^2

$$r = \sqrt{\bar{O}} \qquad \ldots (1)$$

The frequency of O and A persons together is

$$\bar{O} + \bar{A} = r^2 + 2pr + p^2$$

$$= (r+p)^2 \quad \text{or} \quad p+r = \sqrt{\bar{O} + \bar{A}} \qquad \ldots (2)$$

Similarly,

$$\bar{O} + \bar{B} = r^2 + 2qr + q^2$$

$$\text{or} = (r + q)^2 \quad \text{or} \quad q+r = \sqrt{\bar{O} + \bar{B}} \qquad \ldots (3)$$

By substitution, according to (1); of O for r in (2) we obtain

$$p = \sqrt{\bar{O} + \bar{A}} - \sqrt{\bar{O}} \qquad \ldots (4)$$

and by same substitution in (3)

$$q = \sqrt{\bar{O} + \bar{B}} - \sqrt{\bar{O}} \qquad \ldots (5)$$

Adding the three allele frequencies as given by the three equations (4), (5) and (1) we find

$$p + q + r = \sqrt{\bar{O} + \bar{A}} - \sqrt{\bar{O}} + \sqrt{\bar{O} + \bar{B}} - \sqrt{\bar{O}} + \sqrt{\bar{O}}$$

since $p + q + r = 1$, may be expressed finally as

$$\sqrt{\bar{O} + \bar{A}} + \sqrt{\bar{O} + \bar{B}} + \sqrt{\bar{O}} = 1 \qquad \ldots (6)$$

Equation (6) together with the theory of multiple allele can be tested by determining the frequencies of O, B and A persons in different populations and entering these frequencies in left side of the equation. If the theory of multiple alleles is correct, the left side of the equation will always equal to 1. However, for the present study. The allele frequencies are calculated by using Bernstein improved formula (1930).

Thus provisional frequencies of p', q', and r', are estimated, based on the above formulae and subsequently corrected to calculate the definite gene frequencies p, q, r,

$$p' = 1 - \sqrt{(\bar{B} + \bar{O})/n} \qquad P = p' (1+D/2)$$

$$q' = 1 - \sqrt{(\bar{A} + \bar{O})/n} \qquad q = q' (1+ D/2)$$

$$r' = \sqrt{\bar{O}/n} \qquad r = (r' + D/2) (1+ D/2)$$

Where D is the difference between 1 and the sum of p' + q' + r'. Estimates using this improved Bernstein method were shown to be practically identical with the maximum likelihood estimate.

PHENYLTHYOCARBAMIDE:

A large number of populations have been examined for ability to taste PTC round the world, and is another genetically controlled polymorphism.

No obvious association between distribution of this trait and altitude, humidity, extremes of climate or other environmental factors have been found. Though there is some evidence of association between tasting ability and diseases. For example, non-tasters are more likely to have goiter than tasters (Harris and Trotter, 1949) while nontaster males are increasingly susceptible to multiple Thyroid adenomas, a kind of cancer (Kitchin et al., 1959). Athyreotic cretinism, a type of dwarfism is found to be more frequent among non

taster while tasters are more susceptible to diffuse goiter (Fraser, 1961). Becker and Morton (1964) reported that non tasters develop open angle glaucome more frequently and angle-closure glaucomaless more frequently and angle-closure glaucomaless frequently than tasters. The study of this trait is of much importance from genetic and environmental point of view.

There exists an ethnic variation in respect of this genetic marker. Sufficient data are now available from various Indian ethnic groups. If the ability or inability to taste PTC is due to a pair of alleles T and t, persons with one of the two phenotypes must be homozygous recessive and those with the other can be either heterozygous or homozygous dominant. If the taster parents actually consists of both TT and Tt genotypes, the allele frequency relations, assuming random mating, give the proportion of these types P^2 and 2pq; and that of non-tasters (tt) as q^2. By the use of these frequencies, it in possible to predict the proportions of taster and non-taster children resulting from groups of marriage of two tasters, even though it is unknown whether an individual taster parent is homozygous or heterozygous. Phenotypically there are two types of relevant marriage.

(A) Marriages between a taster and a non-taster are of two types as shown below:

Marriages		Offspring	
Type	Frequency	Taster	Non Taster
TT x tt	$2\ p^2\ q^2$	$p^2\ q^2$	-
Tt x tt	$4\ pq^3$	$2pq^3$	$2pq^3$
Total =	$2\ p^2\ q^2 + 4\ pq3$		

Among these there are $2pq^3$ non tasters; hence, the expected fraction of nontasters among all offsprings of these marriages is

$$\frac{2\ pq^3}{2p^2q^2+4pq^3} = \frac{q}{P+2q} = \frac{q}{1-q+2q} = \frac{q}{1+q} \qquad \ldots (1)$$

(B) Similarly, we can calculate the fraction of non taster offspring from marriages of tasters to tasters. There are three types of such marriage.

Marriages		Offspring	
Types	Frequency	Tasters	Non taster
TT x TT	p^4	p^4	-
TT x Tt	$4\ p^3q$	$4p^3q$	-
Tt x Tt	$4\ p^2q^2$	$3p^2q^2$	p^2q^2

Here, the fraction of non-tasters among all offspring is,

$$\frac{p^2\ q^2}{p^4 + 4p^3q + 4p^2q^2} = \frac{q^2}{p^2+4pq+4q^2} = \left(\frac{q}{P+2q}\right)^2 = \left(\frac{q}{1+q}\right)^2 \ldots (2)$$

Formulae (1) and (2) enable us to test the hypothesis of single factor inheritance of taster ability, provided the frequency, q of the allele is known.

The estimation of allele frequency of taste sensitivity can be done as follows:

$$t = \sqrt{\text{no. of non taster}}$$

$$T = 1 - t$$

REPRODUCTIVE BEHAVIOUR AND FERTILITY PATTERN

To a human biologist population is not merely comprise of a number of individuals living in one particular area but it is breeding community with multivarious system of marriage, mate selection, family and reproductive patterns. The reproductive pattern of human population are controlled by a number of socio-biological factors. Various socio-cultural forces are sometime found to be more powerful in determining the net fertility of population than the biological capacity of population for reproduction (Banerjee 1980). Patterns of age at marriage, family planning, birth controls and the prevailing fashion of family size are considered as some of the important factors for controlling the innate reproductive capacity of the population. Few parameters considered in the present study like menarche, menopause and fertility are discussed.

Menarche:

Menarche is the onset of menstruation, through which an individual attains puberty. The events completely depends on gonadotrophic hormone, FSH and LH, secreted by anterior pituitary gland. Throughout childhood, the ovaries are not stimulated by these hormones, hence remain inactive. A gradual increase of gonadotrophic hormone starts approximately at the age of 8 years and at 9 to 10 years, the pituitary begins to secrete progressively more FSH and LH, culminate in the initiation of sexual cycle between the ages 11 to 16 years (Guyton, 1991). This period of change is called puberty and the menstrual cycle is called Menarche.

Menarche is the most commonly reported indicator of female adolescence. Age at menarche varies considerably among populations. White girls experience menarche earlier than black girls by about 9 months (Chaning et al, 1987). Late achievement of menarche is observed among Mongoloid (Sharma, 1990, Das et al 1989). The age at menarche also depends upon various other factors, like nutrition, socio-economic factors, psychological and physiological status (Komlos, 1989; Rohini and Reddy, 1986; Chakravartti, 1986; Balasuriya and Farnando, 1988). Therefore, average age at menarche finds applications in a variety of context; (1) an excellent overall comparative indicator of population health (2) Timing of maturation and nutritional status (3) Demographic

indicator of population fecundity (4) Measure of reproductive risk and (5) public health planning.

Menopause:

At the age of 40-50 years the sexual cycle usually, become irregular, and ovulation fails to occur during many of the cycles and successively cease altogether. This period during which the cycle and the female sex hormone diminish rapidly and stops finally is called menopause.

A female who reaches puberty at age 12 and ovulate 12 mature eggs per year (one in every month) for 40 years requires 480 oocytes. While literally hundreds of thousand of the ova degenerate At the age of about 45 years only a few primordial germ cells still remain to be stimulated by FSH and LH and the production of estrogen by the ovary decreases as the number of primordial germ cells approaches to zero. Estrogen are produced in subcortical quantities for a short time after the menopause, but over a few years as the final remaining primordial germ cells become arctic, the production of estrogen by the ovaries falls almost to zero (Guyton, 1991).

The menopause or loss of reproductive capacity is not a sudden process. The time or period depends upon socio-economic factors and health culture as of menarche. Many authors observed that good health may delay the age at menopause.

Fertility:

Natural fertility - the net genetic potentiality of producing offspring can be defined as the fertility that exists in the absence of deliberate use of birth control measures. Studies have shown that there is a negative correlation between the fertility and the education of spouses (Rele and Kantikar, 1974, Ritchey, 1975). Young (1971) reported a different fertility rate for the different world population. However, the fall of birth rates in European countries and Japan is due to use of birth control measures (Matsunaga, 1966). In India family planning and birth control measures are gradually being accepted but the impact of the above measure is yet to be thoroughly assessed. The work on these lines have been investigated by Pakrasi and Haldar (1980) Chakrarborty and Malakan (1980).

The estimation of agewise fertility and mortality have been done after Chakravartti (1986) and Das et al (1989) by dividing the total number of conceptions, live births, survivors and total child loss (including Miscarriage and still births) by the corresponding number of women (ever married).

For the purpose of comparison standard statistical methods viz. student 't' test and chi-square tests have been employed.

The main objects of the present dissertation may thus be outlined as follows:

1. To estimate the gene frequencies in respect of ABO blood group and PTC of the muslims of Goalpara.

2. To compare the gene frequencies of these two traits of Goalpara with other groups, Hindu caste groups as well as the tribal groups within and outside the state.

3. To see the fertility behaviour of the two groups of Muslims with special reference to interaction with environmental indicators.

4. To estimate the fertility rate among the two muslims groups of Goalpara.

5. To assess the ethnic affinity of the population groups studied from the point of human evolution.

REVIEW OF EARLIER RESEARCH

REVIEW OF EARLIER RESEARCH

Goalpara, a district of Assam of North-East India provides shelter to numerous population of various ethnic affiliations having different social structure and cultural heritages. This geographical region therefore, may be regarded as a laboratory for human population geneticists where different theories could be tested and new ideas and thought to be formulated and developed. The nature and direction of evolution are controlled by the interaction of hereditary and environmental factors. Hereditary tendency modifies the response to environmental factor, being itself modified in course of time and the environmental factors are created by man endowed with hereditary tendencies.

The present review of earlier research deals especially with ABO blood groups, PTC taste sensitivity and Reproductive behaviour and fertility pattern.

ABO blood group:

Pre independent North-East (NE) India has only a very limited sets of ABO blood group data. In one of the earliest record, Mitra (1936) examined the ABO blood group of the Assamese of the plains, Angami Naga and Lushai tribes. Later Basu (1938) and Macfarlane (1941) screened two sets of Khasi data in respect of ABO blood groups. British Association (1939) described two sets of Naga blood groups.

Post independent serological investigation in North-East India was initiated by Das (1960). He reported the ABO blood group data of the Rabha tribes of Assam. The data were compared with the available data on the tribes and caste groups of North East India to assess their ethnic affinity. Das (1968) re-examined the ABO blood groups in the tribal population of North East India with special reference to the Khasis. Phookan (1974) also attempted such a study on the Kacharis of Assam. In addition to ABO blood groups he also examined the phenylthiocarbamide (PTC) taste sensitivity of the Kacharis. Das et al (1973) measured genetic distances in respect of ABO blood groups among four castes of Assam. Das et al published a series of work on Anthropometric, Dermatoglyphic as well as ABO and PTC taste sensitivity among Mongoloid (1985a). Muslims (1985b), Brahmin group (1986a), Kalitas (1986b), four lower caste groups (Hiras, Jogis, Kumars and Kaibartas) in 1986c and in 1988 (Danker-Hopfe et al) studied differentiation of processes among Assamese populations.

The ABO blood group of the Khasi was done earlier by Basu (1938), Macfarlane (1941), Miki et al (1960), Flatz et al (1972) and Das (1968). The Naga samples were analysed by Mitra (1936); Bhattacharjee (1957) and and by British Association (1939). The Rabhas and Garos were examined by Das (1960) and Majumdar (1950). Some of the Tripura tribes were blood grouped by Gupta (1958) and Kumar and Shastri (1961). Of the Arunachal tribe, the Galong were studied by

Kumar (1954) while Minyog, Padam, Pangi, Pasi and Nocte by Bhattacharjee (1957, 1949).

Of the ancestral tribal population ABO blood grouping of the Lalung was done by Das et al (1980a). The Mikir were blood grouped by Chakravarty (1976). Deb (1979) and Das (1981). The blood group of Koch was studied by Sengupta (1987). Ahom and Wancho were studied in respect of ABO blood group by Sengupta and Dutta (1980).

Das (1972) first studied the distribution of ABO blood group among the Assamese muslims. Hasmat Ali (1974) studied the blood group distribution among the Muslims and Hindus of Kamrup district. In 1980 Das studied biological affinity of the Hindus and Muslims of Assam in respect of ABO along with other genetic traits. In an other study Das et al (1985b) reported district-wise distribution of ABO blood group on Muslim in which a comparison was made between the muslim groups of different districts.

In addition to Assam, data of ABO blood group especially in Muslims are reported by various workers in different states of India. ABO blood group in Manipur was first reported by Chakravartti (1986). Shah and Singh (1986) also did report the same but found a very significant variation between the two studies in Manipur. Majumdar and Bahadur (1951-52) studied ABO blood group frequencies among

the Muslims of Bengal as well as other muslim population of India, Srivastava (1978) reported ABO blood group distribution in Muslims, Shia, Sunni, Pathans, Sayyed and Sheikhs of U.P. Majumdar 1943 also studied Sunni and Shia muslims of U.P. Bansal et al (1983) studied Shia and Sunni in Punjab. The allele frequencies of Ladakhi Muslim were presented muslim by Bansal (1967) and Kaur et al 1977).

Seshadrinathan and Timothy (1942) have reported the blood group frequency of the Muslims of Madras. Sunni Muslim of Madhya Pradesh (MP) has been studied by Srivastava (1978). A rare order of blood group frequencies has been reported by Gupta and Singhal (1989) from Hariparigam of Srinagar and compared the same with other muslim groups of India. The available data of Goalpara from male samples only has been reported by Das et al (1980c and 1985b)

Serological studies in NE India is mainly confined to the ABO blood group determination and the estimating the percentile occurrence of the ABO genes and the comparison between the various population groups especially to assess their ethnic affiliation.

Phenylthiocarbamide (PTC):

The search for the gene for taste ability for PTC in Assam was initiated by Miki et al. (1960). They tested the Khasi and Lepcha for this genetic trait. Subsequently Mahapatra and Das (1968) tested the PTC on some endogenous

groups (including Muslim group) of Assam. This trait was studied on Kumar by Das and Ghosh (1970). In 1971 much works have been reported on PTC taste sensitivity among the peoples of Assam. Das (1971) analysed the data to find intra and inter-tribal relationship with regard to this genetic marker. Das and Buragohain (1971) tested this trait on Koet and Baishya. Srivastava (1971) reported PTC taste sensitivity among two mongoloid groups (Adi and Nocte) of NETA. Kacharis of Assam was tested by Phookan (194). Mikir of Assam were studied by Dass (1976), the work of Das et al. (1979), Das (1984-85), Sengupta (1980) and Das et al (1985a,b; 1986a,b,c) were however, worthmentioning in this connection.

Reproductive Behaviour and Fertility pattern

Studies on reproductive behaviour or fertility investigation have been found to be very scanty in Assam. Very recently Das et al (1989) studied certain bio-social variables, including age at menarche, age at marriage, age at first child and the history of reproductive life, in three Assamese populatins. Bhowmick and Bhowmick (1967) and Bhowmick et al (1971) studied reproductive life and fertility respectively in Zemi Nagas. Chakravartti (1986) reported the reproductive life on Manipuri women in her book people of Manipur.

The first Indian data for menarcheal age was reported by Robertson (1845). In Assam Mikir was studied by Khatoniar

(1972) in this regard. Age at menarche in Adi women of Arunachal was studied by Duarah (1969) while Singhpho of the same state have been studied by Kar and Mahanta (1975). Recently Deka (1976) studied Kachtari, a tribal group of Assam, while a Mongoloid group of Assam namely Ahom was compared with other population groups of Assam.

Age at menarche was studied by Malik and Hauspie (1986) on high altitude Bods of Ladakh. The correlation between the fertility mortality and anaemic status of mother in West Bengal was observed by Bharati and Basu (1990). Sharma (1990) reviewed the same in North West Indian female in respect of age at menarche.

The review, reveals that more or less basic data on various population groups on the distribution of ABO blood groups and taste sensitivity are being accumulated by and large, though very few in reproductive behaviour. Such studies have much importance in understanding the part played by the selection as well as human evolution. It is further encouraging to note that in North East India, there is a trend of research in human genetics which will enlighten the ethnic affiliation of the various population groups in time and space.

LAND AND PEOPLE:

The undivided Goalpara district situated on both sides by the river Brahmaputra was the Western most district of the

state of Assam. The district laid between latitude $25^{0}28'$ and $26^{0}54'$ North and longitude 89^{0} 42' and $90^{0}06'$ East. On the North it was bounded by the mountaneous regions of Bhutan, on the East by Kamrup (now Barpeta) district, on the South Gora hills district of the state of Meghalaya and on the West Bangladesh. Kochbehar and Jalpaiguri district of West Bengal. The district was comprised with three subdivisions, namely Dhubri, Kokrajhar and Goalpara till 1983. For the convenience of administration, the three subdivisions are converted into three districts on 1st July 1983. The Goalpara district with subdivision Goalpara and North Salmara further converted into two districts viz. Goalpara and Bongaigaon for the same reasons on 23rd August 1989. Now the present district of Goalpara with 1958 sq. km. as against total land area of 10,359.0 sq. km of undivided Goalpara (Barooah 1979) lies on the southern bank of river Brahmaputra haemed by Bongaigaon district and part of Dhubri districts on the North, part of Dhubri district on the West, Barpeta district on the East while the south by the Garo hills district of Meghalaya.

MUSLIMS:

The two major religious groups of the district are the Muslims (40.42 per cent of population) and the Hindus (53.76 per cent of population) as against state's 24.56 per cent and 72.51 per cent Bhuyan (1988). The high percentage of Muslim in the district may be due to a number of ecological, politico-temporal and socio-economic factors that have been

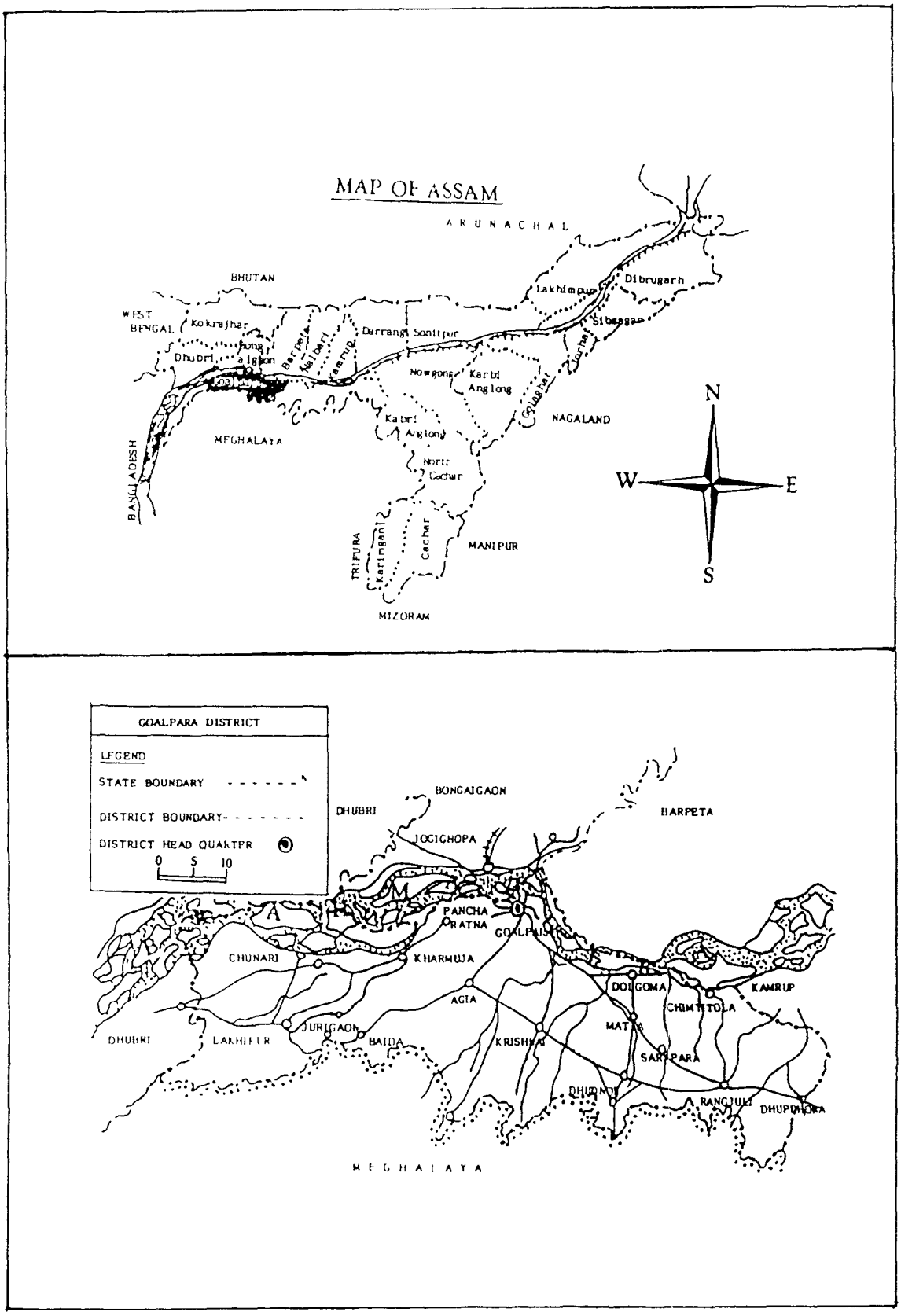
instrumental from time to time. The unoccupied vast char (alluvial) areas of the district have attracted the immigrant muslim cultivators since early period of the present century. On the other hand, the partition of India, internal disturbances and economic hardship of the people in East Pakistan (Now Bangladesh) have also impact on concentration of the muslim in the district.

An analysis shows that 98.61 per cent of the Muslim population of the district live in the rural areas as against the state's 95.97 per cent and the country's 71.2 percent. Of the Hindu population, 87.68 percent live in the rural areas as against the 89.48 percent for the state and 81.6 percent for the country. It may be concluded for this fact that both the Muslim and Hindus of the district are more rural in character. The Muslims are more rural than those of Hindus in the area under study. This is primarily because of the dominance of the immigrant muslims of the district who generally live in the low lying rural areas. This is unlikely to be true in the case of indigenous Muslims a good number of whom settled in the core areas of the town, therefore regarded as urban Muslim.

Agriculture is the primary means of livelihood for the rural Assamese Muslims. However, it is by a number of subsidiary occupations like wage labour and various rural types of petty trade and commerce. The occupational pattern,

is however, much more diversified among the urbanised Muslims. A business as well as professional section has emerged among the urban Muslims.

The present data of Muslims has been sampled from four villages from rural concentrations namely, Dekdua, Baladmari Char I and II and Karbala and four villages from Goalpara (urban) namely, Bhatipara, Nayapara, Krismatpur, and Kalpana Nagar of the Goalpara district.


MAP OF ASSAM
ARUNACHAL
BHUTAN
WEST BENGAL
Kokrajhar
Dhubri
Barpeta
Nalbari
Darrang
Sonitpur
Lakhimpur
Dibrugarh
Sibsagar
Jorhat
Golaghat
Nowgong
Karbi Anglong
NAGALAND
MEGHALAYA
BANGLADESH
North Cachar
TRIPURA
Karimganj
Cachar
MANIPUR
MIZORAM
N
W
E
S
GOALPARA DISTRICT
LEGEND
STATE BOUNDARY
DISTRICT BOUNDARY
DISTRICT HEAD QUARTER
0 5 10
BONGAIGAON
DHUBRI
BARPETA
JOGIGHOPA
PANCHA RATNA
GOALPARA
CHUNARI
KHARMUJA
AGIA
DUDGOMA
KAMRUP
CHIMTOLA
MATIA
SARUPARA
JURIGAON
BAIDA
KRISHNAI
DHUBRI
LAKHIPUR
DHUBRI
RANGJULI
DHUPDHARA
MEGHALAYA

CHAPTER - I

THE ABO BLOOD GROUPS

ABO blood group which Landsteiner discovered in 1900 has been widely used as criteria for racial classification by geneticists and physical anthropologists alike. The classification of mankind, tells something about the history of human race or the mode and path of human descent. Mourant (1954) and many anthropologists are of the opinion that racial classification based on ABO blood group gives greater accuracy than with any other anthropometric characters.

Later studies showed that the surface of specific blood cells contain specific protein, now known as antigens. The blood cells which contain isoaglulinogen A known as type A blood while type B contains isoglulinogen B. Persons with type A were shown to have a factor in the serum portion of their blood causing the agglutination or clumping of type B cells when the two types were mixed, and those with type B shown to have factor that caused the clumping of type A cells. The serum of type A contains antibody α and the serum of the B contains antibody β Type O blood does not contain either antigen A or antigen B, but does contain both the antibodies, while reverse is true in the case of type AB.

The genetic theory of ABO blood group was first postulated by Dungern and Hirsfeld in 1910 and elaborated upon by Bernstein in 1925. ABO blood group antigens are controlled by three alleles: i, I^A and I^B at a single

locus (multiple alleles); I^A and I^B being dominant to each other, while i being recessive cannot be expressed phenotypically in presence of either of the other two alleles. Dominant relationship of the three alleles is represented as $(I^A = I^B) > i$. If O is regarded as normal phenotype and A and B are said to represent two dominant mutations then genotypically blood **groups** can be represented as:

Phenotype	**Genotype**
A	$I^A I^A$ or $I^A i$
B	$I^B I^B$ or $I^B i$
AB	$I^A I^B$
O	ii

These blood groups are inherited in the simple Mendelian fashion.

An uncommon subgroups of A has been discovered in 1911 as group A_1, A_2. Later, other subgroups A_3 and A_4 have been found. According to their inheritance it is found that A_1 is dominant over A_2, A_3, A_4; A_2 is dominant over A_3 & A_4 and so on. Three slightly different variants of type B have also been reported. Nevertheless blood types A, B, O, and AB are important from blood transfusion point of view the sub groups of A are relevant to certain legal problem.

The present study, will be dealt with four broad division of ABO osystem only. The study aims to find out its genes and genotype frequencies among the Muslims of Goalpara district of Assam and to assess their ethnic affinity with other groups of Muslims as well as other racial groups of other districts of Assam. An attempt will also be made to compare the present sample with samples of other states of India.

Materials and Methods

The survey and collection of data for the present study were done between April and May and October and November in 1990 from two distinctly divided areas of the district Goalpara, Assam - one from the remotest part of the district (rural) and the other from predominantly urban concentration.

Blood samples were collected by finger pricking techniques (peripheral blood). The samples were collected in test tubes containing solution of 0·38 gms percent of sodium citrate used as anticoagulant. The anticoagulant was prepared with one litre of distilled water added with 3.8 gms. of sodium citrate. The blood thus collected was mixed gently with careful shaking. After washing the red cells suspension with 0.9 percent of sodium chloride solution twice or thrice, the centrifuge was used. The grouping was done by slide method with the human antisera marketed by M/S DE CRUZ and Co., Bombay.

One drop of washed blood cells was put on the slide against one drop of known antisera. The nature of the agglutination was noted as weak or strong. After every 20 samples, the known controls were tested to verify the antisera as well as the technique.

A careful recording of the ABO blood group determination was entered in the exercise book.

For calculation of different gene frequencies, Bernstein's improved formula was used (1930). The standard statistical analysis based on chi-square test have been applied for the purpose of elaborate comparative studies.

Results and Discussion:

The distribution of ABO blood groups and their allele frequencies of two distinctly divided groups of Muslims of Goalpara are presented in Table 1.1. It is evident from the results that frequency of each and every blood groups in both Muslim groups of Goalpara are almost similar. The frequency of B is the highest and closely followed by O. The frequency of A blood group is low while AB remains the lowest in the population groups examined. The chi-square value (χ^2 = 1.23, 0.80 > P>0.70) do not show any significant difference between the two samples and hence are pooled for the purpose of comparison with other studies.

TABLE 1.1: DISTRIBUTION OF ABO BLOOD GROUPS (IN %) AND ALLELE FREQUENCIES IN TWO MUSLIM GROUPS OF GOALPARA

POPULATION GROUP	BLOOD GROUP				ALLELE FREQUENCIES		
	n	O	A	B	AB	P	q	r
RURAL	255	33.33	21.57	37.65	7.45	0.158	0.260	0.582
URBAN	469	30.49	24.95	37.31	7.25	0.178	0.257	0.564
COMBINED	724	31.49	23.76	37.43	7.32	0.171	0.258	0.571

X^2 = 1.23, 3 d.f. 0.80 > P > 0.70

Table 1.2 reports sex-wise distribution of ABO blood group and their allele frequencies along with chi-square values between the two sexes of the two Muslim groups of Goalpara. Results show that allelic frequency of q is higher in both the sexes and groups than allelic frequency of p, whereas r allele as usual is the highest. In all the cases the phenotype B is highest among the groups studied, where sequence of phenotypes appear as B>O>A>AB and gene frequencies r>q>p. The chi-square values do not show any significant differences between the sexes of the groups indicating homogeneity in the samples collected. The genotypic frequency, however, show a different picture which is ii> IB^i > I^Ai > $I^A I^B$> I^BI^B> $II^A I^A$ (Table 1.3).

Figures (1-7) explain the equilateral triangle proposed by Penrose are drawn on the basis of gene frequencies indicating the homogeneity and heterogeneity of Muslim groups of Goalpara (Shukla and Tyagi 1973). All the figures represent a higher proportion of homozygous ii individuals closely followed by I^Bi and I^Ai heterozygous.

The larger area of triangle occupied by quadrilateral indicates that there are more heterozygous individuals than homozygous. These figures also prove one more fact that triangle for $I^B I^B$ individuals and larger quadrilateral for I^B i individuals indicate that Isoagglutinogen B is more frequent than Isoagglutinogen A.

TABLE 1.2: SEX-WISE DISTRIBUTION OF ABO PHENOTYPES AND THEIR ALLELE FREQUENCIES AMONG TWO MUSLIM GROUPS OF GOALPARA

POPULATION GROUP	SEX	BLOOD GROUP					ALLELI FREQUENCIES			$X^2_{(3)}$
		n	O	A	B	AB	P	q	r	
RURAL	MALE	105	37 (35.24)	19 (10.09)	41 (39.05)	8 (7.62)	0.138	0.270	0.594	-
	FEMALE	150	48 (32.00)	36 (24.00)	55 (36.67)	11 (7.33)	0.172	0253	0.575	1.293 0.80>P>0.70
	COMBINED	255	85 (33.33)	55 (21.57)	96 (37.65)	19 (7.45)	0.158	0.260	0.582	-
URBAN	MALE	204	63 (30.88)	47 23.04)	78 (38.23)	16 (7.84)	0.170	0.267	0.563	0.81 0.90>P>0.80
	FEMALE	265	80 (30.10)	70 (26.41)	97 (36.60)	18 (6.79)	0.185	0.250	0.565	
	COMBINED	469	143 (30.49)	117 (24.95	175 (37.31)	34 (7.25)	0.178	0.257	0.564	

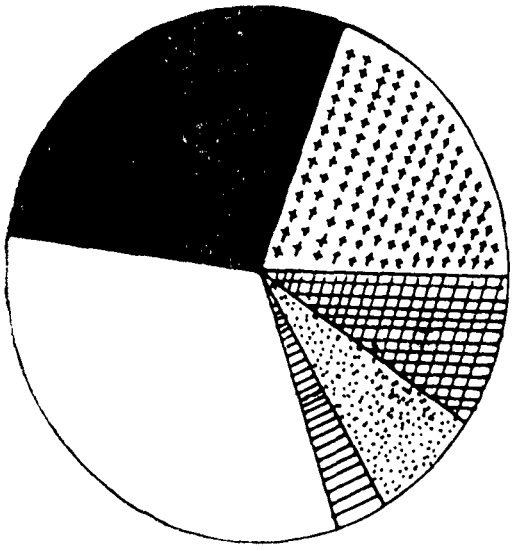


Table: 1:3 Genotypic frequencies among the Muslims of Goalpara.						
ii	$I^B i$	$I^A i$	$I^A I^B$	$I^B I^B$	$I^A I^A$
r^2	2qr	2pr	2pq	q^2	p^2
0.326	0.295	0.195	0.088	0.067	0.029

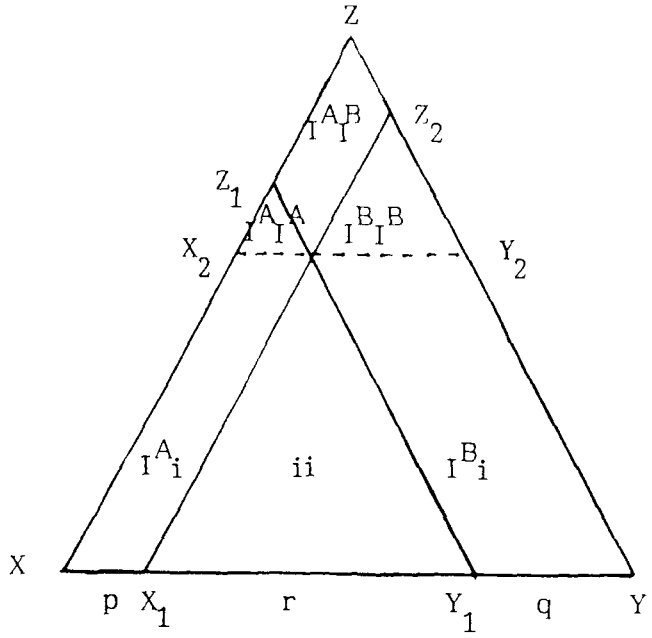


Fig. 1.1 PENROSE'S EQUILATERAL TRIANGLE SHOWING ALLELE FREQUENCIES IN RURAL MALE

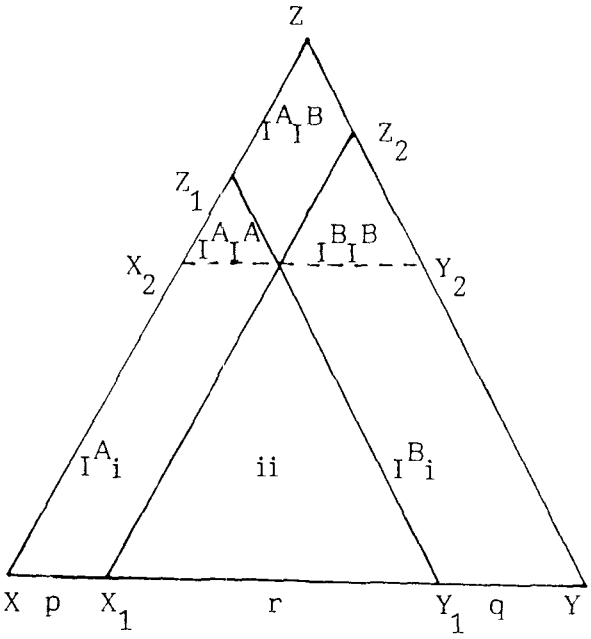


Fig.1.2 PENROSE'S EQUILATERAL TRIANGLE SHOWING ALLELE FREQUENCIES IN RURAL FEMALE

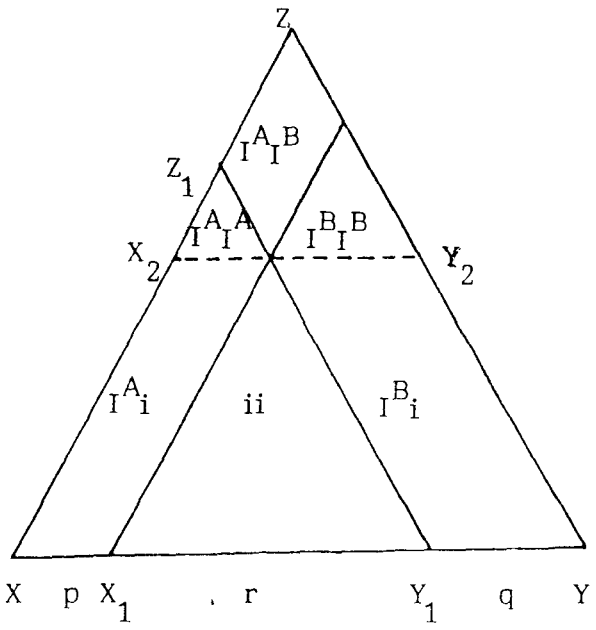


Fig.1.3 PENEROSE'S EQUILATERAL TRIANGLE SHOWING ALLELE FREQUENCIES IN URBAN MALE

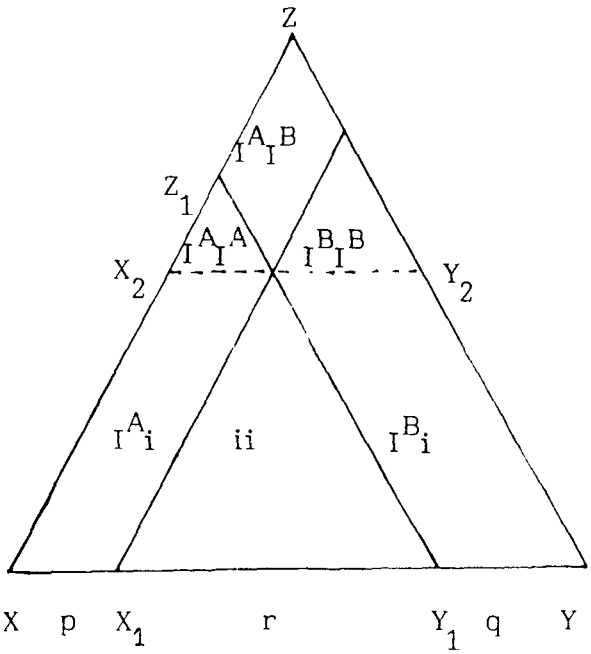


Fig.1.4 PENROSE'S EQUILATERAL TRIANGLE SHOWING ALLELE FREQUENCIES IN URBAN FEMALE

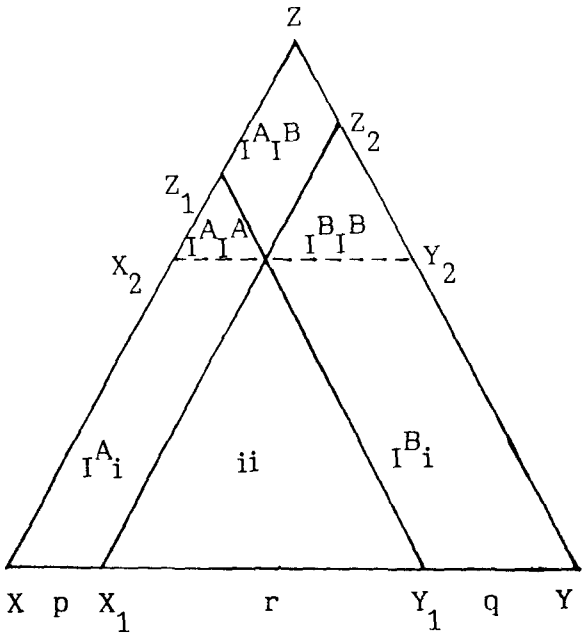


Fig. 1.5 PENROSE'S EQUILATERAL TRIANGLE SHOWING ALLELE FREQUENCIES IN RURAL MUSLIM OF GOALPARA (Male-female pooled)

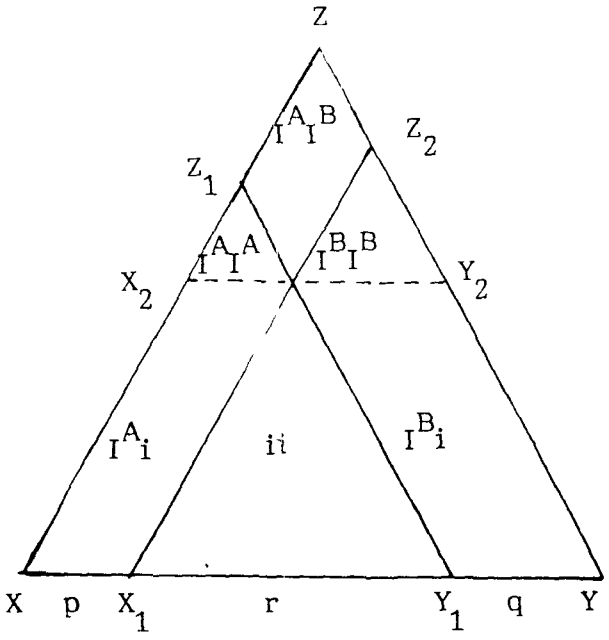


Fig. 1.6 PENROSE'S EQUILATERAL TRIANGLE SHOWING ALLELE FREQUENCIES IN URBAN MUSLIMS OF GOALPARA (Male-female pooled)

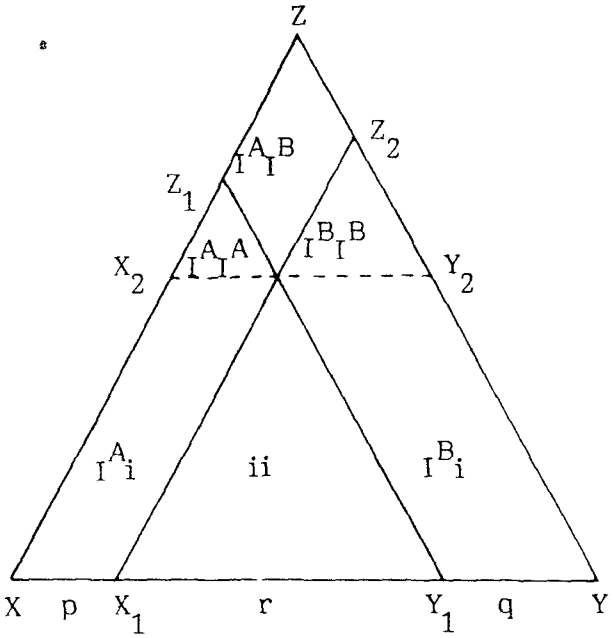


Fig. 1.7 PENROSE'S EQUILATERAL TRIANGLE SHOWING ALLELE FREQUENCIES IN MUSLIMS OF GOALPARA (POOLED)

COMPARISON WITH OTHER MUSLIMS OF ASSAM

A comparative account of the population and regionwise variation in the distribution of ABO blood groups in Assam has been summarized in Table 1.4. Contrary to the present study wherein B blood group is most prevalent, it is O in various other studies. Blood group A and B occur almost in equal frequencies. A closer look of the results reveals that genetic equilibrium is present in all the groups except the Muslim group from Nowgong. In this group an excess of AB and O phenotypes is existing, whereas A and B phenotypes are showing a deficit. The above observations are summarized as follows (Das et al 1985b).

Blood groups	**Observed**	**Expected**
O	30	21.62
A	27	37.51
B	16	26.82
AB	27	14.05
	100	100.00

Among the Muslims of Nowgong district, the occurrence is almost different with the order O>A>AB>B while in Goalpara II the order being B>O>A>AB, the B relegated to the first place. In Kamrup district I and Dibrugarh I series the occurrence appear to be O>A>B>AB. In Kamrup II series it is

TABLE 1.4: PERCENTILE OCCURRENCE OF ABO PHENOTYPES, ALLELE FREQUENCIES AND THEIR PROBABILITIES OF MUSLIMS OF DIFFERENT DISTRICTS OF ASSAM

DISTRICTS	NO.	O	A	B	AB	P	q	r	$X^2(1)$	PROBABILY	SOURCE
GOALPARA I	110	44.50	18.20	28.20	9.10	0.145	0.206	0.649	2.6190	0.20> P>0.10	Das et al 1985b
GOALPARA II	724	31.49	23.75	37.43	7.32	0.171	0.258	0.571	3.0100	0.10> P>0.05	Present Study
KAMRUP I	318	35.00	29.20	27.00	8.80	0.212	0.199	0.589	0.0750	0.80 P>0.70	Das et al 1985b
KAMRUP II	150	43.30	18.00	29.30	9.30	0.146	0.215	0.639	3.3900	0.10> P>0.05	Ali 1974
DARRANG	114	36.00	28.10	29.80	6.10	0.190	0.201	0.609	0.5120	0.50>P> 0.30	Das et al.1985b
NOWGONG	100	30.00	27.00	16.00	27.00	0.304	0.231	0.465	22.4940	P<0.001	-do-
SIBSAGAR	94	50.00	12.80	35.10	2.10	0.078	0.208	0.714	00.4940	0.50>P> 0.30	-do-
DIBRUGARH I	101	56.40	25.70	14.90	3.00	0.156	0.093	0.751	00.0020	0.98>P 0.95	-do-
DIBRUGARH II	112	40.18	20.53	33.03	6.25	0.145	0.222	0.633	0.0100	P>0.99	Das 1972
TOTAL	1823	36.92	23.70	31.10	8.28	0.175	0.221	0.604	0.84	0.50>P>0.30	

$X^2_{(24)}$ = 120.66, P <.001 Significant

O>B>A>AB. The same trend is also found in Goalpara I, Darrang, Sibsagar and Dibrugarh II.

Profiles of frequencies of three alleles p, q and r behave in a different manner. This would be interpreted as below:

r>P>q	r>q>P
a. Kamrup I	a. Goalpara I
b. Nowgong	b. Goalpara II
c. Dibrugarh I	c. Darrang
	d. Sibsagar
	e. Kamrup II
	f. Dibrugarh II

The homogeneous distribution of blood groups in each of the group is further confirmed from the studies summarized in table 1.4. However, this is not so in Nowgong observation where highly hetergeneous mixture of population in respect of ABO blood group is evident (X^2 = 22.494, 1 d.f. P <0.001). Total sample of Assam (including present study) does not show significant difference. (X^2 = 0.84 0.50>P>0.30). However, a highly significant intergroup difference (X^2 = 120.66 P <0.001) indicates a great deal of heterogeneity among the groups.

In an another set of observation when present sample is compared with muslims of other district of Assam by

different authors, the chi-square values show significant differences except Darrang and Dibrugarh II (Table 1.5).

The three co-ordinate graphs (Fig. 1.8) depicts that Goalpara I, Kamrup II, Dibrugarh II and Darrang are clustered around a point, Goalpara II and Kamrup I have the tendency towards clustering around the point while Nowgong, Sibsagar and Dibrugarh deviated from the point. However, Goalpara I and Goalpara II which are apart form each other show heterogeneity among these two groups.

In an another elaborate comparative study of various Indian Muslim population is attempted and their phenotypes and allelic order are summarized in table 1.6 to 1.8. It is evident that in most of the populations the phenotype frequency emerged as B>O>A>AB and the allele frequency r>q>p which are in conformity with our studies. An exceptional and very rare order of phenotype frequency A > AB > B > O with allele frequency p>r>q arises from Hariparigam of Srinagar (Gupta and Singhal, 1989).

Analysis of three co-ordinate graph based on some selected muslim population of India show interesting interpretation (Fig. 1.9). Of the 20 populations, 15 of them are clustering around one point, whereas the other populations viz. Ladakhi muslim I, Sayyad of U.P., Shias of Malerkotla, Manipuri Muslim I and Sunnis of Hariparigam show deviation. The last being more distantly situated is thought

TABLE 1.5: COMPARISON WITH OTHER MUSLIM GROUPS OF ASSAM

POPULATION	X^2	PROBABILITY	REMARKS
GOALPARA II - GOALPARA I	8.565	0.05> P>0.02	Significant
GOALPARA II - KAMRUP I	10.930	0.02> P>0.01	Significant
GOALPARA II - KAMRUP II	9.950	0.02> P>0.01	Significant
GOALPARA II - DARRANG	3.180	0.50> P>0.30	Non-significant
GOALPARA II - NOWGONG	47.070	P≤0.001	Significant
GOALPARA II - SIBSAGAR	16.390	P≤0.001	Significant
GOALPARA II - DIBRUGARH II	31.660	P≤0.001	Significant
GOALPARA II - DIBRUGARH II	3.070	0.50> P>0.30	Non-significant

df = 3 , in all cases.

TABLE 1.6: DISTRIBUTION OF ABO BLOOD GROUPS AMONG THE MUSLIMS OF INDIA

S. N.	POPULATION	PLACE	TOTAL NO.	BLOOD GROUPS				ALLELE FREQUENCIES			AUTHOR
				O	A	B	AB	p	q	r	
1.	MUSLIM I	LADAKH	60	-	-	-	-	0.1840	0.3300	0.4860	Bansal 1967
2.	MUSLIM II	LADAKH	93	-	-	-	-	0.2300	0.2300	0.5180	Kaur et al 1977
3.	MUSLIM	U.P.	669	29.30	27.50	33.33	9.86	0.2090	0.2470	0.5440	Srivastava 1978
4.	SHEIKHS	U.P.	377	29.18	26.26	33.69	10.87	0.2070	0.2550	0.5380	-do-
5.	PATHANS	U.P.	207	32.85	28.50	29.47	9.18	0.2100	0.2170	0.5730	-do-
6.	SAYYAD	U.P.	85	20.93	22.13	31.24	10.52	0.2150	0.2870	0.4960	-do-
7.	SUNNI MUSLIM	U.P.	220	33.18	21.82	33.64	11.36	0.1810	0.2562	0.5629	Majumdar 1943
8.	SHIA MUSLIM	U.P.	106	35.85	25.47	33.96	4.72	0.1661	0.2190	0.6149	-do-
9.	SUNNIS	KALER-KOTLA	150	29.33	31.33	33.33	6.00	0.2410	0.2240	0.5410	Bansal et al 1983
10.	SHIAS	MALER-KOTLA	80	25.00	33.70	26.25	15.00	0.2810	0.2320	0.4950	-do-
11.	SUNNIS	HARI-PARIGAM	100	10.00	58.00	13.00	19.00	0.5090	0.1640	0.3160	Gupta & Singhal 1989
12.	SUNNIS	MADRAS	141	31.21	28.37	38.30	2.13	0.1702	0.2334	0.5964	Sheshadrinathan & Timothy 1942
13.	SUNNIS	M.P.	425	31.06	29.65	34.82	4.47	0.191	0.2240	0.5840	Srivastava 1978
14.	MUSLIM	W.B.	354	33.33	23.73	33.90	9.04	0.1663	0.2552	0.5785	Bhattacharjee 1956
15.	MUSLIM	BENGAL	120	28.33	23.33	40.00	8.33	0.1745	0.2830	0.5424	Majumdar 1951-52
16.	MUSLIM I	MANIPUR	200	43.00	21.50	27.00	8.50	0.1500	0.1800	0.6700	Shah & Singh 1986
17.	MUSLIM II	MANIPUR	227	29.03	33.92	26.87	10.13	0.2000	0.1800	0.6200	Chakravarti 1986
18.	MUSLIM I	ASSAM	837	40.00	25.10	25.70	9.20	0.1880	0.1920	0.6200	Das et al 1985b.
19.	MUSLIM II	ASSAM	112	40.18	20.53	33.03	6.25	0.1450	0.2220	0.6330	Das 1972
20.	MUSLIM	GOALPARA	724	31.49	23.76	37.43	7.32	0.1710	0.2580	0.5710	Present Study.

TABLE 1.7: THE ORDER OF ABO BLOOD GROUP FREQUENCIES AMONG THE INDIAN MUSLIM

O>B>A>AB	B>O>A>AB	A>O>B>AB	B>A>O>AB	A>B>O>AB	A>AB>B>O
1. SHIA (U.P.)	1. U.P.	1. MANIPUR II	1. SUNNI'S (KALER-KOTLA)	SHIA (MALER-KOTLA)	SUNNI'S (HARIPARIGAM)
2. MANIPUR I	2. SHEIKH (U.P.)				
3. ASSAM I	3. SAYYAD (U.P.)				
4. ASSAM II	4. SUNNI (U.P.)				
5. PATHANS (U.P.)	5. SUNNI (MADRAS)				
	6. SUNNI (M.P.)				
	7. W.B.				
	8. BENGAL				
	9. GOALPARA (PRESENT STUDY)				

TABLE 1.8: ORDER OF ALLELE FREQUENCIES OF ABO BLOOD GROUPS AMONG THE MUSLIM POPULATIONS OF INDIA

P < r > q	r < P > q	r > q > P	r > P = q
1. SUNNI'S (HARIPARIGAM)	1. SUNNI'S (KALER-KOTLA)	1. LADAKH	LADAKH II
	2. SHIAS (MALER-KOTLA)	2. U.P.	
	3. MANIPUR II	3. SHEIKH (U.P.)	
		4. PATHANS (U.P.)	
		5. SAYYAD (U.P.)	
		6. SUNNIS (U.P.)	
		7. SHIAS (U.P.)	
		8. SUNNI (M.P.)	
		9. W.B.	
		10. BENGAL	
		11. SUNNIS (MADRAS)	
		12. MANIPUR I	
		13. ASSAM I	
		14. ASSAM II	
		15. GOALPARA (Present Study)	

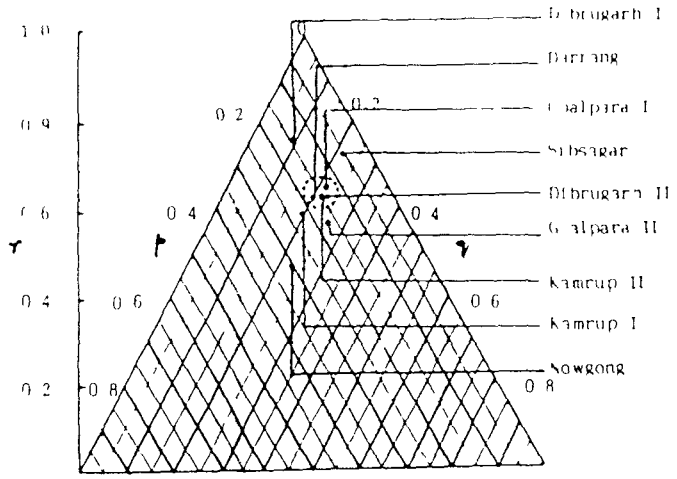


Fig 1.8 THREE CO ORDINATE GRAPH REPRESENTING ABO GENE FREQUENCIES IN SOME ASSAMESE MUSLIM GROUPS (Table - 3)

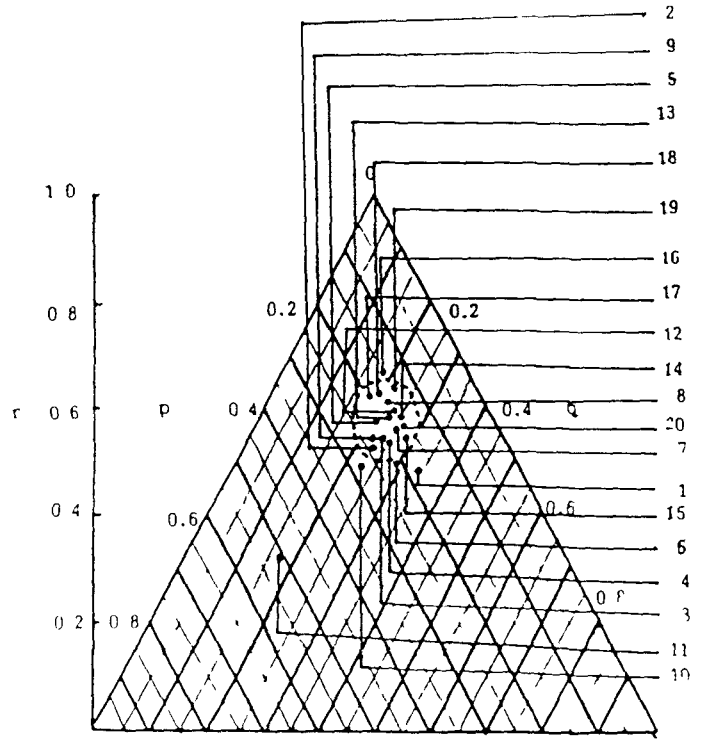


Fig.1.9 THREE CO-ORDINATE GRAPH REPRESENTING ABO GENE FREQUENCIES IN SOME MUSLIM POPULATIONS OF INDIA (Table - 5)

to be attributed to the inbreeding prevalent among them (Gupta and Singhal, 1989). The figure also signifies that the present Muslim sample is in conformity with the Muslims of other states or within the state of Assam.

In a similar studies (Table 1.9 and 1.10) Das (1980) found no significant differences between the Muslims and other caste Hindus barring Kaibarta. Das et al (1973) already observed the above facts and showed Kaibarta have in them some Dravidian traits and occupies the lowest position of the Hindu caste hierarchy. Another reason may being its continual isolation as a result of endogamy.

When our present sample is compared with other caste Hindus and tribal groups of Assam it appears that Muslim do not show significant difference from higher caste Hindus (Table 1.11 and 1.12). The chi-square being 7.52 at 3 d.f. indicate homogeneity due to admixture of genes between the groups. While lower caste Hindus and tribal groups show deviation from the Muslims. However, Muslim when compared with Hindu (pooled) shows significant differences (X^2 = 16.90, 3 d.f. P <0.001).

It is apparent from the present study that B genes occurs more frequently than A gene. This is almost similar to those of other Indian population groups studied so far. The present study also agrees with Roychoudhary (1981), that

TABLE 1.9: PERCENTILE OCCURRENCE OF ABO BLOOD GROUPS AND THEIR ALLELE FREQUENCIES

POPULATION	n	O	A	B	AB	P	q	r	SOURCE
MUSLIM									
GARIA	316	39.24	23.41	31.33	6.01	0.164	0.213	0.623	Das (1980)
MARIA	155	48.39	22.59	21.93	7.09	0.149	0.145	0.706	-do-
HINDU									
BRAHMIN	360	38.33	23.05	33.05	5.55	0.157	0.214	0.628	Das et al 1973
KALITA	454	38.54	24.22	31.29	5.94	0.165	0.208	0.626	-do-
BAISHYA	145	48.27	22.76	24.82	4.13	0.146	0.158	0.696	-do-
KAIBARTA	65	40.37	11.80	44.09	3.74	0.078	0.274	0.642	-do-

TABLE 1.10: CHI-SQUARE VALUES OF ABO BLOOD GROUPS

POPULATION	VALUE	P	REMARKS
MUSLIM-BRAHMIN	2.559	0.50>P>0.30	Insignificant
MUSLIM-KALITA	1.685	0.70>P>0.50	Insignificant
MUSLIM-BAISHYA	2.340	0.70>P>0.50	Insignificant
MUSLIM-KAIBARTA	18.544	P<.001	Significant

d.f. 3 in all the cases.

TABLE-1.1] : ABO PHENOTYPE FREQUENCIES IN VARIOUS POPULATION GROUPS

POPULATION	n	O	A	B	AB	P	q	r	AUTHOR
HIGHER CASTE									
BRAHMIN	536	35.6	21.6	32.8	10.0	0.171	0.242	0.586	Das et al, 1986
KALITA	454	38.54	24.22	31.29	5.94	0.165	0.208	0.626	Das et al, 1973
POOLED	990	36.97	22.89	32.12	8.08	0.169	0.227	0.605	-
LOWER CASTE									
HIRA	266	47.4	20.7	24.8	7.1	0.149	0.174	0.677	Das et al, 1986
JOGI	411	43.8	25.5	26.3	4.4	0.164	0.468	0.668	-do-
KUMAR	202	34.1	21.8	41.1	3.0	0.134	0.256	0.610	-do-
KAIBARTA	532	32.1	28.6	31.2	8.1	0.205	0.222	0.573	-do-
BAISHYA	145	48.2	22.7	24.8	4.1	0.146	0.158	0.696	Das et al, 1973
POOLED	1684	39.2	25.0	29.0	6.7	0.200	0.178	0.621	
TRIBAL									
KOCH	527	31.3	30.3	26.7	5.5	0.200	0.178	0.621	Sengupta, 1987
RABHA	726	25.3	32.2	30.1	12.2	0.255	0.241	0.503	Das , 1981
GARO	144	25.7	29.9	32.6	11.8	0.236	0.255	0.507	Das , 1981
KACHARI	532	28.7	25.9	32.9	12.4	0.213	0.259	0.527	Phookan ,1975
LALUNG	94	29.8	33.0	31.9	5.3	0.218	0.211	0.570	Das et al, 1980a
MIKIR	414	28.9	30.7	33.0	7.2	0.214	0.230	0.555	Chakravarty, 1976
POOLED	2437	29.5	30.0	30.7	9.7	0.224	0.229	0.547	
TRIBE									
MUSLIMS									
ASSAMESE	837	40.0	25.1	25.7	9.2	0.145	0.221	0.620	Das et al, 1985b
MUSLIM									
GARIA	316	39.2	23.4	31.3	6.0	0.164	0.213	0.623	Das, 1980
MARIA	155	48.4	22.6	21.9	7.1	0.149	0.145	0.706	Das, 1980
GOALPARA	724	31.5	23.7	37.4	7.3	0.171	0.258	0.571	Present study
MUSLIMS									

TABLE - 1.12: COMPARISON WITH OTHER CASTE GROUPS OF ASSAM

Population	Chi-Square value	Probality	Remarks
Muslim - High Caste	7.52	0.10>P>0.05	Insignificant
Muslim - Low Caste	20.15	P<0.001	Significant
Muslim - Tribal	19.72	P<0.001	Significant
Muslim - Hindu (Pooled)	16.90	P<0.001	Significant

d.f. = 3

regional variation in gene frequencies seems to be greater than the variation between castes and religious groups in one region. The higher incidence of B over A allele is attributed to natural selection.

The trend of homogeneity between the population support the suggestions of having ethnohistoric background. Sometimes, it may happens that two groups with no common link have got the same values of gene frequencies and becomes difficult to explain. This may be due to selection of the group and partly due to small size of the smaple (Majumdar and Bahadur, 1951-52). Therefore it becomes difficult to draw any conclusion on the present sample regarding their origin by considering only just one marker.

It will not be without interest to cite those observation arising out of blood groups and diseases, however, for the present no such relation was saught after. Vogel and Chakravartti (1966) have found that incidence of small pox is higher in A and AB groups than B and O groups. Mourant (1974) stated that genetic polymorphism are the results of an equilibrium, varying with locality between the selective effects of different diseases and other environmental stresses on the various phenotypes of any given system. However, Chung and Morton (1961) proposed that the principal mechanism of selection which maintain ABO polymorphism act during foetal and early post natal stages.

CHAPTER - II

PHENYLTHIOCARBAMIDE (P.T.C.)

The Phenylthiourea or Phenylthiocarbamide (PTC), a chemical substance is a member of large antithyroid molecule. Although it has a bitter taste to most of the people, there is a sizable minority who either can not taste it or require high concentration to recognise its presence. This substance occurs naturally in many foods and is ingested by human in varying amounts (Whissel-Buechy and Wills 1989).

The ability to taste PTC is inherited as an autosomal dominant trait and is followed simple Mendelian principle (Hogben, 1946; Strandskov, 1941; and Stern, 1973). The person who can identify taste can be either homozygous (TT) or heterozygous (Tt) tasters. While non-tasters are homozygous (tt) recessive. The recognition of the differential ability to taste PTC came about in a curious manner. Fox (1931) who chemically synthesized the substance can not sense the bitter taste of the compound. Another person however, mentioned the Compound's bitterness to Fox (Stine, 1977). Further studies disclosed that what is tasted is the chemical group N-C-S of the PTC.

Several methods have been used to classify people according to their taste sensitivity to PTC. The first method is to put few crystals of substance on the tongue; People who perceive bitter taste are recognised as 'taster', otherwise non-tasters (Snyder, 1932; Blakeslee and Salmon, 1931; Riddle

and Wybar, 1944; Kloepfer, 1946 and others). Another method of detection is to use impregnated filter paper or PTC paper, now commercially available. The third method has been proposed by Blakeslee and Salmon (1935) employing the use of solutions in serial dilution.

The variation in the incidence of taste sensitivity to PTC has been extensively studied in the world population. It is no less in Indian population. However, data on taste sensitivity to PTC from Assam are very few and on Muslim of Goalpara district is more scanty. Das et al (1979, 1985b) have studied this trait with a very small sample which is inconsistant to draw conclusion.

The object of present study is to report on the incidence and to estimate their gene frequencies of this genetic trait among the Muslim of Goalpara district. It is further intended to see the religio-ethnic affinity among the people of Assam and neighbouring states. A possible relationship between tasting ability to that of sex and age is also attempted.

MATERIALS AND METHODS

The data for the present study was collected from eight villages - four from the remotest part of the district and the rest from urban concentration during the month April and May 1990 and October and November 1990.

Threshold were studied by serial dilution of phenylthiourea (PTC). A stock solution of PTC was prepared by dissolving 0.13 gm of crystals in 100 ml of distilled water and numbered it as solution number 1. The solution number 2 was half a solution number 1 (0.065 gm %), solution number 3 was half of solution number 2 (0.0325 gm %) and so on till solution number 14 (0.000016 gm %). Individuals who failed to taste any of the solution were classified as 0. The respondent was given solution number 14 (lowest concentration) first to taste it, then solution number 13 and so on. The solution at which he or she perceived any taste was recorded as his or her taste threshold number (T.S.N.). Only in doubtful cases was the sorting technique of Harris and Kalmus (1949b) employed.

RESULTS AND DISCUSSION

The distribution of test of ability to taste phenylthiourea (PTC) and the taste threshold of individuals among the two Muslim groups of Goalpara are presented in table 2.1. It appears from the table that the frequencies in both the groups are highest at threshold number 7 and covered upto 12 (Fig. 2.1 to 2.3). The mean threshold value however, differ significantly from each other (Table 2.4). The t value being 6.1. It is also evident from the table that rural Muslim can taste higher dilution of PTC than urban.

TABLE 2.1: DISTRIBUTION OF PTC TASTE THRESHOLD AMONG THE TWO MUSLIM GROUPS OF GOALPARA, ASSAM

POPULATION GROUPS		T.S.N.															TSN MEAN ± SE
	n	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
RURAL	187	80	-	2	4	9	7	9	24	23	17	3	7	2	-	-	7.26
	%	42.78	-	1.07	2.14	4.18	3.74	4.18	12.83	12.30	9.09	1.60	3.74	1.07	-	-	±0.21
URBAN	376	143	13	8	20	27	36	33	45	33	10	7	-	1	-	-	5.69
	%	38.03	3.46	2.13	5.32	7.18	9.57	8.78	11.96	8.78	2.66	1.86	-	0.27	-	-	±0.14
COMBINED	563	223	13	10	24	36	43	42	69	56	27	10	7	3	-	-	6.18
	%	39.61	2.31	1.78	4.26	6.39	7.64	7.46	12.26	9.95	4.80	1.78	1.24	0.53	-	-	±0.13

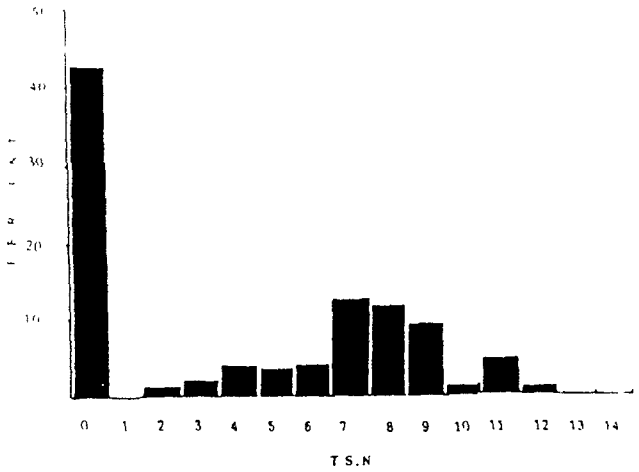


Fig.2.1 HISTOGRAM SHOWING THE TASTE THRESHOLD IN RURAL MUSLIMS OF GOALPARA.

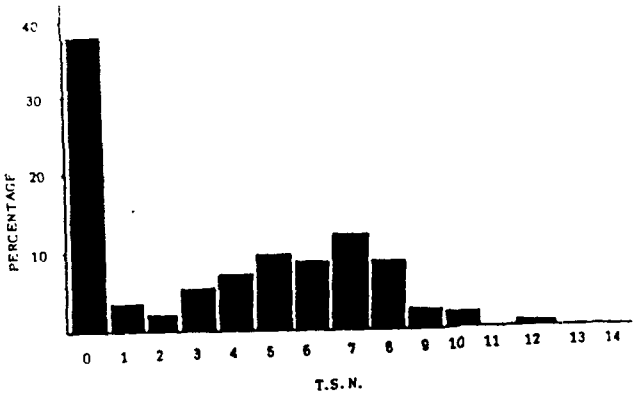


FIG.2.2 HISTOGRAM SHOWING TASTE THRESHOLD IN URBAN MUSLIMS OF GOALPARA.

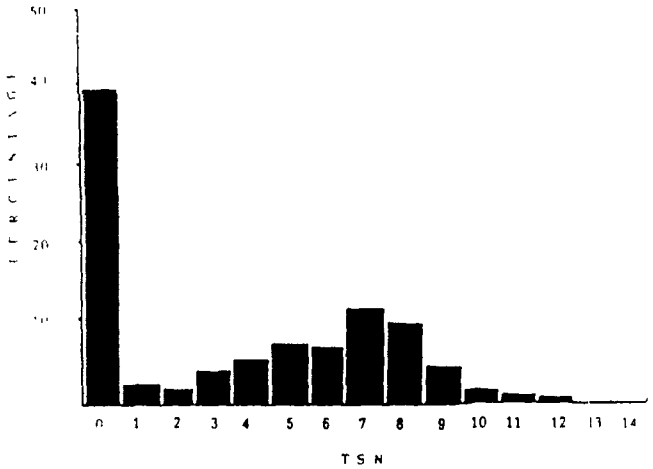


Fig 2.3 HISTOGRAM SHOWING P.T.C. TASTE SENSITIVITY AMONG THE MUSLIMS OF GOALPARA DISTRICT

The percentage frequencies and allele frequencies of tasters and non-tasters have been calculated after noting that the antimode is at solution number 1 in both the series and is shown in table 2.2. Of the two groups of Muslims urban Muslims have highest frequency of tasters (61.97%) while the rural muslims have the highest frequency of non tasters (42.78). The chi-square value shows no significant difference between the two series (X^2 = 1.16, df = 1. 0.30> P > 0.20) indicating homogeneity between the two samples.

Table 2.3 examines the PTC taste threshold between the two sexes of the two samples of Muslims of Goalpara. It is evident from the table that at each individual group the mean taste threshold values in females are more than males indicating, females can on the average detect higher dilution of PTC than their male counterparts (Fig 2.4 and 2.5). It is also evident that females are more sensitive to PTC than males. Both chi-square and 't' values do not show any significant differences between the two sexes of the two series, however 't' values of the same sex of the two groups when compared show significant differences (Tables 2.4).

It appears from table 2.5 that a tendency towards deterioration in taste sensitivity to PTC with increase of age occurred in both groups of Muslims (Fig. 2.6).

TABLE 2.2: FREQUENCY OF TASTERS AND NON-TASTERS AMONG TWO MUSLIM GROUPS OF GOALPARA

POPULATION GROUPS	n	TASTERS		NON-TASTERS		ALLELE FREQUENCY	
		No.	%	No.	%	p^t	q^t
RURAL	187	107	57.22	80	42.78	0.346	0.654
URBAN	376	233	61.97	143	38.03	0.383	0.617
COMBINED	563	340	60.39	223	39.61	0.371	0.629

$X^2 = 1.16$, df = 1, $0.30 > P > 0.20$

TABLE 2.3: SEX-WISE VARIATION IN DISTRIBUTION OF PTC TASTE THRESHOLD AMONG THE TWO MUSLIM GROUP OF GOALPARA

POPULATION GROUPS		T.S.N.																TSN MEAN ± SE
	SEX	n	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
RURAL	MALE	52	23	-	1	2	2	3	3	7	2	6	1	1	1	-	-	6.93
		%	44.23	-	1.92	3.85	3.85	5.77	5.77	13.46	3.85	11.54	1.92	1.92	1.92	-	-	±0.45
	FEMALE	135	57	-	1	2	7	4	6	17	21	11	2	6	1	-	-	7.38
		%	42.22	-	0.74	1.48	5.18	2.96	4.44	12.59	15.55	8.15	1.48	4.44	0.74	-	-	±0.24
	COMBINED	187	80	-	2	4	9	7	9	24	23	17	3	7	2	-	-	7.26
		%	42.78	-	1.07	2.14	4.18	3.74	4.18	12.83	12.30	9.09	1.60	3.74	1.07	-	-	±0.21
URBAN	MALE	169	67	5	4	9	15	19	14	13	15	5	3	-	-	-	-	5.54
		%	39.64	2.96	2.37	5.32	8.87	11.24	8.28	7.69	8.87	2.96	1.77		-	-	-	±0.22
	FEMALE	207	76	8	4	11	12	17	19	32	18	5	4	-	1	-	-	5.81
		%	37.71	3.86	1.93	5.31	5.79	8.21	9.18	15.46	8.69	2.41	1.93	-	0.48	-	-	±0.20
	COMBINED	376	143	13	8	20	27	36	33	45	33	10	7	-	1	-	-	5.69
		%	38.03	3.46	2.13	5.32	7.18	9.57	8.78	11.96	8.78	2.66	1.86	-	0.27	-	-	±0.14

TABLE 2. 4: COMPARISON AMONG THE TWO MUSLIM GROUPS

Groups	Chi square values	't' values
Rural Male x Rural female	0.06	0.94
Urban Male x Urban female	0.34	0.91
Rural Male x Urban Male	0.35	2.95^{+}
Rural female x Urban female	1.04	4.98^{++}
Rural x Urban	1.16	6.1^{++}

d.f. for Chi-square, 1 and t-test, infinity

Statistically significant + indicates 0.01 > P > 0.001

+ indicates P < 0.001

TABLE 2.5: PROPORTION OF NON-TASTERS IN THE THREE AGE GROUPS

Age Group	Rural			Urban		
	No.	Taster	Non taster	No.	Taster	Non taster
19	40	26	14	209	141	68
	%	(65.0)	(35.0)		(67.5)	(32.5)
20-44	108	61	47	127	71	56
	%	(56.5)	(43.5)		(55.9)	(44.1)
45 +	39	20	19	40	21	19
	%	(51.3)	(48.7)		(52.5)	(47.5)

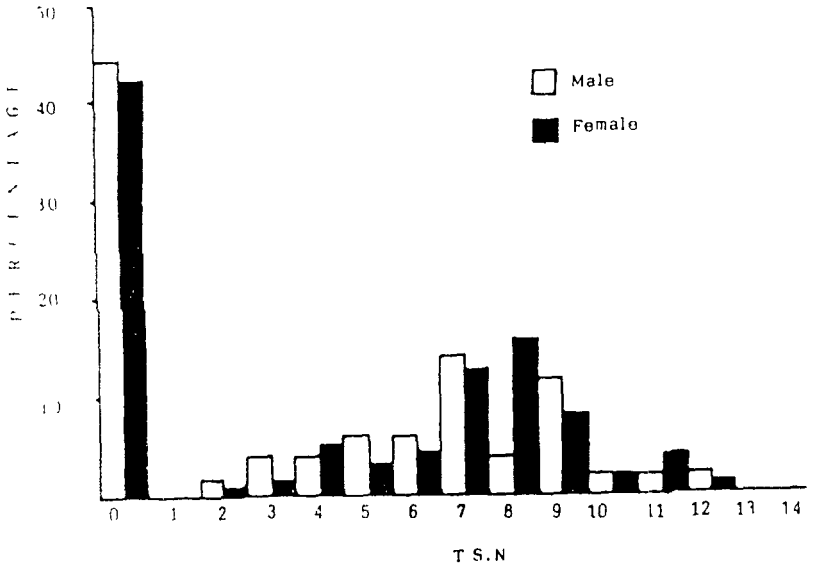


Fig.2.4 HISTOGRAM SHOWING MALE FEMALE RELATIONSHIP IN RESPECT OF PTC TASTE SENSITIVITY AMONG RURAL MUSLIMS.

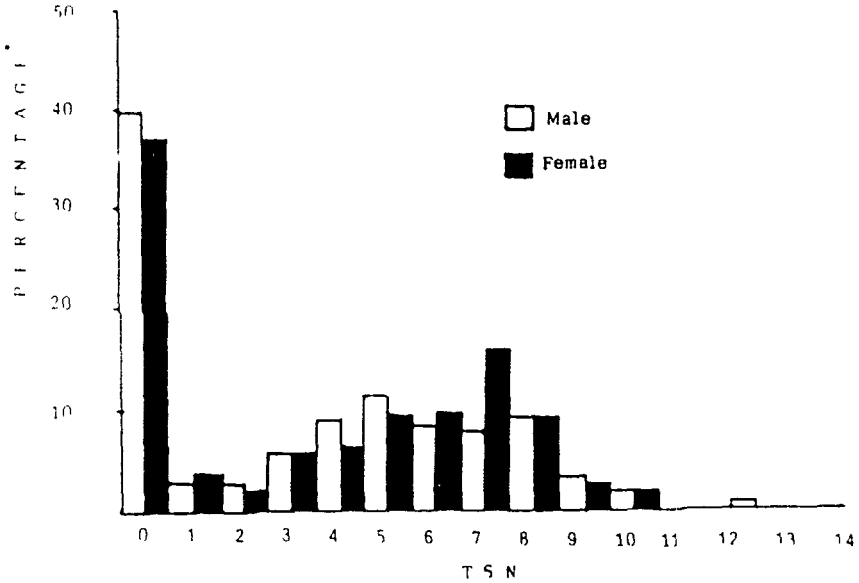


Fig.2.5 HISTOGRAM SHOWING MALE FEMALE RELATIONSHIP IN RESPECT OF PTC TTASTE SENSITIVITY AMONG URBAN MUSLIMS

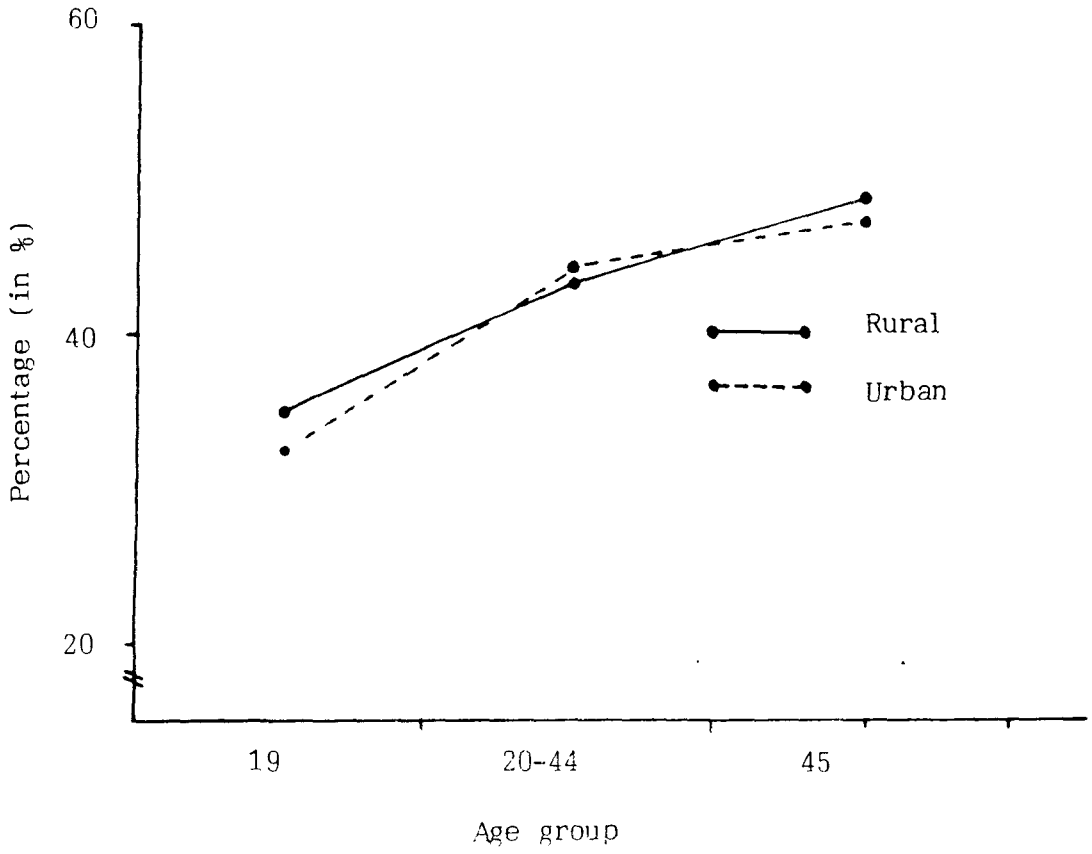


Fig 2.6 RELATIONSHIP BETWEEN TASTING ABILITY AND AGE.

COMPARISON WITH OTHER ASSAMESE MUSLIMS

District wise variation of PTC taste sensitivity among the Muslim groups of Assam is presented in Table 2.6. It is apparent from the table that the highest frequency of non-tasters is observed in Goalpara II (present study, 39.61%) in contrast to the finding of Das et. al., 1985b in Goalpara I (10.5%). A considerable inter group variability is also evident. The heterogeneity of the distribution of allele frequencies was found to be statistically significant (X^2 = 64.15, d.f=6, P <.001). When present sample compared with each of the sample groups of Das et al. (1985b) highly significant differences between Goalpara I and Goalpara II (X^2 = 33.04, df = 1 P <0.001) and Goalpara II and Darrang (X^2 = 31.70, df = 1 P <0.001) are observed indicating more heterogeneity than between other groups of Muslims (table 2.7). Muslims (pooled) of Das et al. (1985b) when compared with present data show a significant difference as usual (X^2 = 36.76). But when the same Data compared independently with Mahapatra and Das (1968) and Das (1984-85) reveals no significant differences, indicating homogeneity amongs the Muslims.

The mean taste threshold with standard error of the muslim samples of Assam are shown in table 2.8. It appears from that the mean taste threshold varies between 6.06 $\pm$ 0.34

TABLE 2.6: DISTRIBUTION OF PTC TASTE SENSITIVITY PHENOTYPES (IN %) AND ALLELE FREQUENCIES OF DIFFERENT DISTRICTS OF ASSAM

Districts	n	Taster	Non-taster	p^T	q^+	Sources
Goalpara I	105	89.5	10.5	0.676	0.324	Das et al.1985b
Goalpara II	563	60.39	39.6	0.371	0.629	Present study
Kamrup	317	68.1	31.9	0.435	0.565	Das et al.1985b
Darrang	115	87.8	12.2	0.651	0.349	-do-
Nowgong	100	71.0	29.0	0.461	0.539	-do-
Sibsagar	98	73.5	26.5	0.485	0.515	-do-
Dibrugarh	105	77.1	22.9	0.521	0.479	-do-

$\chi^2 = 64.15$, df = 6, $0.001 > P$ significant

TABLE 2.7: COMPARISON WITH OTHER MUSLIM GROUPS OF ASSAM

Population Group			Chi square values	Probability	Remarks
Goalpara II	Vs.	Goalpara I	33.04	0.001>P	Significant
"	Vs	Kamrup	5.20	0.05>P>0.02	Significant
"	Vs	Darrang	31.70	P<0.001	Significant
"	Vs	Nowgong	4.04	0.05>P>0.02	Significant
"	Vs	Sibsagar	5.96	0.02>P 0.01	Significant
"	Vs	Dibrugarh	10.50	0.01>P>0.001	Significant
Goalpara II	Vs	Pooled Assamese Muslim (Das et al.1985b)	36.75	P<.001	Significant
"	Vs	Assamese Muslim (Mahapatra & Das, 1968)	0.66		Non-significant
"	Vs	Assamese Muslim pooled (Das 1984-85)	0.17		Non-significant

d.f.= 1

TABLE 2.8: MEAN TASTE THRESHOLD OF MUSLIMS OF DIFFERENT DISTRICTS OF ASSAM

Muslim	Mean ± S.E.	Sources
Goalpara I	7.88 ± 0.17	Das et al., 1980c
Goalpara II	6.18 ± 0.13	Present study
Kamrup	8.56 ± 0.14	Das et al., 1980c
Darrang	7.78 ± 0.11	-do-
Nowgong	7.98 ± 0.19	do
Sibsagar	6.06 ± 0.34	-do-
Dibrugarh	6.31 ± 0.38	-do-

TABLE 2.9: FREQUENCY DISTRIBUTION OF TASTERS AND NON-TASTERS AMONG THE VARIOUS POPULATION GROUPS OF ASSAM.

Population Group	Sex	Taster No.	Taster %	Non-taster No.	Non-taster %	Chi square values df = 1
High caste	Males	426	71.84	167	28.16	5.96
	Females	464	77.98	131	22.02	0.02>P>.01
	Combined	890	74.92	298	25.08	Significant
Low Caste	Males	174	85.29	30	14.71	6.73
	Females	76	73.08	28	26.92	0.01>P>.001
	Combined	250	81.17	58	18.83	Significant
Muslims	Males	107	66.45	54	33.55	
	Females	109	69.87	47	30.13	1.04
	Combined	216	68.14	101	31.86	0.30>P>0.20 Non-significant

X^2 = 14.12, df = 2, 0.001 > P significant

to 8.56 ± 0.14 which are in conformity with present data of Goalpara II. (6.18 ± 0.13)

COMPARISON WITH VARIOUS POPULATION GROUPS OF ASSAM

Das et al (1979) reported the distribution of taste - threshold for phenylthiourea (PTC) belonging to high caste, low caste and the Muslim population groups of Assam (Table 2.9). The study reveals that the Muslim groups of Assam show more numbers of non-tasters. Intergroup variability show statistically significant difference (X^2 = 14.12 df = 2 P < 0.001). Das et al. (1979) exists reported no significant difference between the two sexes of the Muslim samples. However, there exists statistical significant differences between the following groups (Table 2.10).

TABLE 2.10: CHI-SQUARE VALUE BETWEEN MUSLIM AND CASTE HINDUS:

Groups	Chi-square values	Probability
Kayastha Vs Muslim	4.15	.05 > P >0.02
Kalita Vs Muslim	8.99	.01 > .001
Kumar Vs Muslim	27.01	.p <.001

Table 2.11 discusses the mean taste threshold values of two sexes of certain Assamese population groups. It is evident that the 't' test fail to show any significant difference between Hindus and Muslims in Assam (Table 2.12).

TABLE 2.11: SEXWISE DISTRIBUTION OF MEAN TASTE THRESHOLD FOR PTC AMONG DIFFERENT POPULATION GROUPS OF ASSAM

Population groups	Mean Taste Threshold	
	Male	Female
Brahmin	7.20 ± 0.26	7.44 ± 0.24
Kayastha	9.10 ± 0.11	9.64 ± 0.08
Kalita	8.67 ± 0.08	8.77 ± 0.06
Kumar	7.71 ± 0.20	7.77 ± 0.19
Jogi	7.61 ± 0.20	8.19 ± 0.33
Kaibarta	6.78 ± 0.15	8.38 ± 0.21
Muslims	8.70 ± 0.14	8.41 ± 0.31

Source: Das et al. (1979)

TABLE 2.12: THE VALUES OF T TEST BETWEEN THE VARIOUS GROUPS

Groups	t values	Ramark
High Caste Vs. Low caste	4.85	Significant
High Caste Vs. Muslim	0.29	Not Significant
Low caste Vs. Muslim	4.18	Significant
Hindu Vs. Muslim	0.80	Not Significant

TABLE 2.13: DISTRIBUTION OF TASTE SENSITIVITY AMONG THE VARIOUS POPULATION GROUPS OF ASSAM

Population group	n	Taster %	Non-taster %	Source
Muslim	563	60.39	39.61	Present study
Brahmin	530	73.4	26.6	Das et al.,1986a
Kalita	310	64.2	35.8	Mahapatra & Das,1968
Baishya	351	64.67	35.2	Das & Buragohain (1971)
Kumar	160	60.0	40.0	Das & Ghosh (1970)
Kumar	185	82.2	17.8	Das et al, 1986c
Hiras	257	88.7	11.3	-do-
Jogis	411	70.6	17.8	-do-
Kaibartas	533	79.2	20.8	-do-

TABLE 2.14: CHI-SQUARE VALUES BETWEEN PRESENT MUSLIMS VERSUS OTHER CASTE HINDUS

Populations	x^2 value	P lies between	Remarks
Muslim Vs High Caste	10.96	0.001>P	Significant
Muslim Vs Low caste	55.9	0.001>P	Significant
High Caste Vs Low caste	24.26	0.001>P	Significant

The t value 4.18, $p<0.001$ between the low caste and Muslim is significant indicating variability between the groups. However, homogeneity is indicated between the High caste and Muslim ($t=0.29$, $p>0.1$).

But when present data compared with pooled high caste data (Das et al, 1986a; Mahapatra and Das, 1968; and Das and Buragohain 1971) and pooled low caste data (Das et al, 1986a; Das and Ghosh, 1970) show statistical significant differences (Table 2.13 and 2.14).

Mahapatra and Das (1968) have compared the frequency of T and t gene distribution among the Muslims of Assam. They did not observe any significant differences among the Brahmin, Kalita as well as Muslim ($X^2 = .005$, $P>.99$). When T and t gene frequencies of our present data compared with that of Mahapatra and Das (1968) the following results emerged (Table 2.15)

TABLE 2.15: VARIATION IN GENE FREQUENCIES BETWEEN TWO SAMPLES.

Groups	Taster	Non-taster	Source
Muslim	0.348	0.652	Mahapatra & Das (1968)
Muslim	0.384	0.616	Present study

Table 2.16 gives non-taster frequencies in North-east (NE) India. Population with Mongoloid connection have lower frequency of non-tasters (2.18-21.4) than those with

TABLE 2.16: NON TASTER FREQUENCIES IN NORH-EAST INDIA

Population	Number tested n	Non-Taster %	Sources
MONGOLOID			
Ahom	123	21.14	Sengupta, 1980
Kachari	864	17.82	Phookan, 1974
Mikir	114	11.40	Dass, 1976
Adi	45	13.33	Srivastava, 1971
Nocte	78	12.82	-do-
Nocte	271	15.12	Kumar, 1955
Khasi	317	2.18	Miki et al 1960
Khasi	838	15.39	Das, 1971
Riang	401	16.21	Kumar & Shastri, 1961
Lepcha	154	7.14	Miki et al 1960
CAUCASOID			
Brahmin	530	26.6	Das et al 1986a
Brahmin	189	39.10	Mahapatra & Das, 1968
Kalita	310	35.80	-do-
Keot	223	36.77	Das & Buragohain, 1971
Baishya	351	35.32	-do-
Hiras	257	11.3	Das et al., 1986c
Jogis	411	29.4	-do-
Kumars	185	17.8	-do-
Kumars	160	40.0	Das and Ghosh
Kaibartas	533	20.8	Das et al 1986c
Muslim	840	24.4	Das et al 1985b
Muslim	275	42.6	Mahapatra & Das 1968
Muslim	563	39.6	Present study

caucasoid connections (11.3 - 42.6). There appears to be a good consistency among all the population of NE India in respect of t gene excepting Khasis (2.18) amongst the mongoloid group and Hiras among the caucasoid group. In general Mongoloid population show low incidence of non-tasters as compared to other non-mongolid populations.

It appears from the foregoing discussion that females are on average taste PTC more than their male counterparts (Hartmann, 1939, Falconer 1947, Harris and Kalmus 1949b, Srivastava 1982), however homogeneity between the two sexes is prevailed. The statistical significant difference between the two groups (t = 6.1) reveals heterogeneity between the groups.

Harris and Kalmus (1949b) suggested that the taste sensitivity decreases with the increase of age. They further mentioned that the number of taste buds in the foliate papillae decreases with age (Mochizuki, 1939). Allara (1939) reported that the gastatory papillae reach full development at puberty and that after the age of 45 years regressive changes set in. The present data also shows the trend towards deterioration with increase of age and are in conformity with previous works and hypothesis put forwarded by various authors (Fig. 2.6).

A distinct biological difference among the different Muslim population groups of Assam are evident. The Muslims of

Goalpara II however, do not show variability with the muslim of Mahapatra and Das (1968) and Das (1984-85), indicating homogeneity among the Muslim of Assam. The two muslim groups (Goalpara I and II) of the same district show highly significant differences (X^2 = 33.04 df:3, p <. 001) as with other Muslim groups of Assam (Das et al 1985b). This can not be due to geographical and ethnic environment or local gene flow through marriage or converts. The possibility of this phenomenon may be either due to sampling fluctuation or personal errors or both while collecting the data. This draws an attention to plan a thorough and careful research investigation in this regard in near future.

Although there appears heterogeneity between Hindu caste groups and Muslim, a low biological variability is evident in high caste Hindus and Muslim. This is in corformity with Srivastava (1982) who found no significant difference between Muslim and high caste Hindus of U.P. (X^2 = 1.293 1 df. 0.30 > P > 0.20) Das et al (1979) also found the same results in Assamese population (t=0.29, p >0.1). Thus one can safely assume that there may be gene flow within the groups through intermarriages and local conversions. Sometimes natural selection may also cause heterogeneity between the groups as selection occurs in response to the levels of iodine or antithyroid substances present in the environment (Harris and Kalmus, 1949a). Therefore environment

play most important role in respect of PTC taste sensitivity among the Human population.

Generally speaking, Mongoloid population of Cis-Himalayan region show low incidence of non-tasters as compared to non-Mongoloid population of the Ganga and Brahmaputra valley who show high incidence of non-tasters i.e. always more than 40% (Mahapatra and Das 1968). The non tasters show further decline as one more eastwards through Burmese, Chinese, Japanese to Amerindans etc. Of the Mongoloid people of North East India Kacharis of Assam compared with Khasis and Nagas and show no variation. Ethnically thus, Muslims of Goalpara comes under caucasoid group in respect of PTC trait (Table 16).

CHAPTER - III

REPRODUCTIVE BEHAVIOUR AND FERTILITY PATTERN

Reproduction, one of the most important attributes for retention of a certain population is the mean through which each generation is replaced by another, thus making its germ cells immortal. The number of individuals in each generation is very important. If fewer than the replacement produced, there will be a decline in population with a subsequent loss of genetic diversity, while again uncontrolled reproduction, though add genetic variation, many individuals would die as a result of excessive competition for limited resources. Therefore, reproduction effect the overall demographic pattern of certain population.

The reproductive behaviour can be studied in a number of ways: the physiological and psychological factors the socio-economic status and finally the demographic aspects. The demographic aspect is studied at the population level mainly in two ways: (a) reproductive performance and (b) reproductive fitness (Fisher, 1930). The reproductive performance includes all the facts of reproductive cycles from menarche to menopause, estimating the rates of conception, foetal loss, neonatal and juvenile deaths etc. Reproductive fitness on the other hand includes parameters like mean number of offspring produced, preadolescent mortality rate, sex ratio, and selection intensity etc. Many

of the above factors concerning fertility and reproductive behaviour have been adopted in the present study.

MATERIALS AND METHODS

The data for the present study was collected from the villages of rural and urban concentrations of the district Goalpara during the month of April and May 1990 and October and November 1990 by household survey. The survey was confined to the evermarried women (individual has generally had a chance to produce offspring). The data collected have been put under two broad groups - rural and urban. Illiteracy being high among the rural group of Muslim, they are least concerned in keeping records of age of different events of life, like age at menarche, age of marriage, age at first child. Therefore, the retrospective method depending on recall had to be applied to obtain the ages at these periods. It is approximately correct upto months, but not day. However, in urban area we need not face much difficulty to obtain ages. The ages were verified from birth records, birth certificates of the offsprings, although retrospective method could not be ruled out in certain cases. The data were based on standard schedule/questionnaire.

RESULTS AND DISCUSSIONS

Age at Menarche:

The age wise distribution of the onset of age at menarche has been described in Table 3.1. It is apparent

from Table that the rural woman experience onset of menarche much earlier than the urban. The mean age at menarche do not show much variation, corresponding figures being 12.27 ± 0.17 and 12.53 ± 0.11 in rural and urban respectively. The range of onset of menarche, however, is large in rural women (9 to 19 years) in contrast to urban (10 to 16 years). These ranges are quite clear for urban and rural women in figure 3.1. The t value (1.17) also show no significant difference between the two groups of women in respect of onset of menarche. Therefore, the two groups are pooled for the purpose of comparison with other groups of population.

Although in this respect an extensive work has been done through-out the country, the data on onset of menarche in Assam is very far and few. A comparative studies in Assam with respect to this event are summarized in Table 3.2.

t values calculation to measure the significance between Muslim of the present study with other populations have been shown in Table 3.3. It is evident that the present data differ significantly from other groups of population barring caste Hindus (Rakshit, 1960 and Sengupta, 1982b). The age at menarche varies considerably from population to population (Eveleth and Tanner, 1976; Danker - Hopfe, 1986; Wellens et al., 1990). Although the mean of menarcheal age observed by Rakshit (1960) and Das et al (1989) can be

argued there is however significant difference between the Muslim groups. This could possibly due to adoption of different methods in various studies.

The mean age of menarche in various population groups of India have been summarized in Table 3.4 and the same have been highlighted in figure 3.2. The mean ages at menarche of women of Assam including present study agree with the mean observed in Bengal. It is also evident that the population with Mongoloid affiliation (Arunachal, Nagaland and Manipur) shows higher values of mean age at menarche (> 14 years). The Manipuri muslim in contrast to present study, have a very early menarcheal age of 10.73 years (Chakravartti, 1986). Such strikingly lower mean values are not reported elsewhere in the world. Hence their authenticity can be doubtful. Perhaps in this study, late menstruators were left out or their age at menarche was not cross-checked. These observations have also been debated by Sharma (1990) on the same ground.

The age at menarche depends on nutritional status, a purely environmental determinant, playing an important role on the onset of menarche, inturn correlated with fertility rate and therefore population growth in societies. The importance of correlation between socio-economic status and many other factors with the menarcheal age has been stressed by many researchers (Rohini and Reddy, 1986; Chakravartti,

TABLE 3.1: DISTRIBUTION OF MENARCHEAL AGE AMONG THE TWO MUSLIM GROUPS OF GOALPARA

AGE AT MENARCHE IN YEARS	RURAL		URBAN	
	n	%	n	%
9	7	5.5	–	–
10	19	14.8	3	3.1
11	24	18.7	6	6.2
12	25	19.5	45	46.9
13	19	14.8	25	26.0
14	14	10.9	14	14.6
15	16	12.5	2	2.1
16	1	0.8	1	1.0
17	1	0.8	–	–
18	1	0.8	–	–
19	1	0.8	–	–
TOTAL	128	100.0	96	100.0
Mean age at Menarche	12.27 ± 0.17		12.53 ± 0.11	

Value of 't' = 1.17 P > 0.1 Non-significant

TABLE 3.2: AGE AT MENARCHE IN SOME POPULATION GROUPS IN ASSAM

POPULATION GROUPS	NUMBER n	MEAN AGE AT MENARCHE ± S.E.	AUTHOR
GOALPARA MUSLIM	224	12.38 ± 0.11	Present Study
AHOM	184	12.60 ± 0.12	Sengupta, 1982
BRAHMIN	60	12.46 ± 0.13	Rakshit, 1960
KAYASTHA	32	12.45 ± 0.20	Rakshit, 1960
KALITA	17	12.12 ± 0.26	Rakshit, 1960
MUSLIM	29	13.35 ± 0.15	Rakshit, 1960
POOLED	138	12.39 ± 0.09	Rakshit, 1960
HINDUS	704	13.20 ± 0.04	Das et al, 1989
MONGOLOID	354	12.80 ± 0.07	Das et al, 1989
MUSLIM	319	13.10 ± 0.10	Das et al, 1989

TABLE 3.3: 't' VALUES OF MUSLIM OF GOALPARA VERSUS OTHER POPULATION GROUPS OF ASSAM

GROUPS	t VALUE	INFERENCE
Muslim Vs. Ahom	1.29	Non-significant
Muslim Vs. Brahmin	0.36	Non-significant
Muslim Vs. Kayastha	0.23	Non-significant
Muslim Vs. Kalita	0.64	Non-significant
Muslim Vs. Muslim	3.13	Significant
Muslim Vs. Pooled	0.06	Non-significant
Muslim Vs. Hindus	9.06	Significant
Muslim Vs. Mongoloids	3.09	Significant
Muslim Vs. Muslim	4.75	Significant

d.f. ∞

TABLE 3.4: MEAN AGE AT MENARCHE IN SOME RELATED POPULATION OF INDIA

POPULATION	NO.	MEAN	AUTHOR
ASSAM			
1. Goalpara	224	12.38	Present study
2. Assam Pooled I	263	12.71	Das and Das 1967
3. Assam Pooled II	138	12.39	Rakshit 1960
4. Assam Pooled III	1377	12.74	Das et al 1989
ARUNACHAL			
1. Adi	109	14.45	Duarah 1969
2. Singphos	95	12.59	Kar & Mahanta 1975
NAGALAND			
1. Zemi-Naga	214	14.13	Bhowmick et al 1971
MANIPUR			
1. Meitei	487	14.34	Chakravartti 1986
2. Kabui Naga	484	15.15	Chakravartti 1986
3. Tangkhul Naga	307	13.93	Chakravartti 1986
4. Muslim	402	10.73	Chakravartti 1986
BENGAL (W.B.)			
All castes	647	12.73	Sen 1953
KERALA (NAYAR)	75	14.29	Sen 1953
MADRAS	-	13.83	Sharma 1990
ORISSA	-	13.21	-do-
MAHARASTRA (Brahman)	103	14.34	Rakshit 1962
ANDHRA PRADESH	-	13.89	Sharma 1990
GUJRAT	-	14.86	Sharma 1990
U.P.	253	13.62	Dubey and Srivastava 1963
J.K.	-	14.13	Sharma 1990
PUNJAB AND DELHI	-	13.53	Sharma 1990

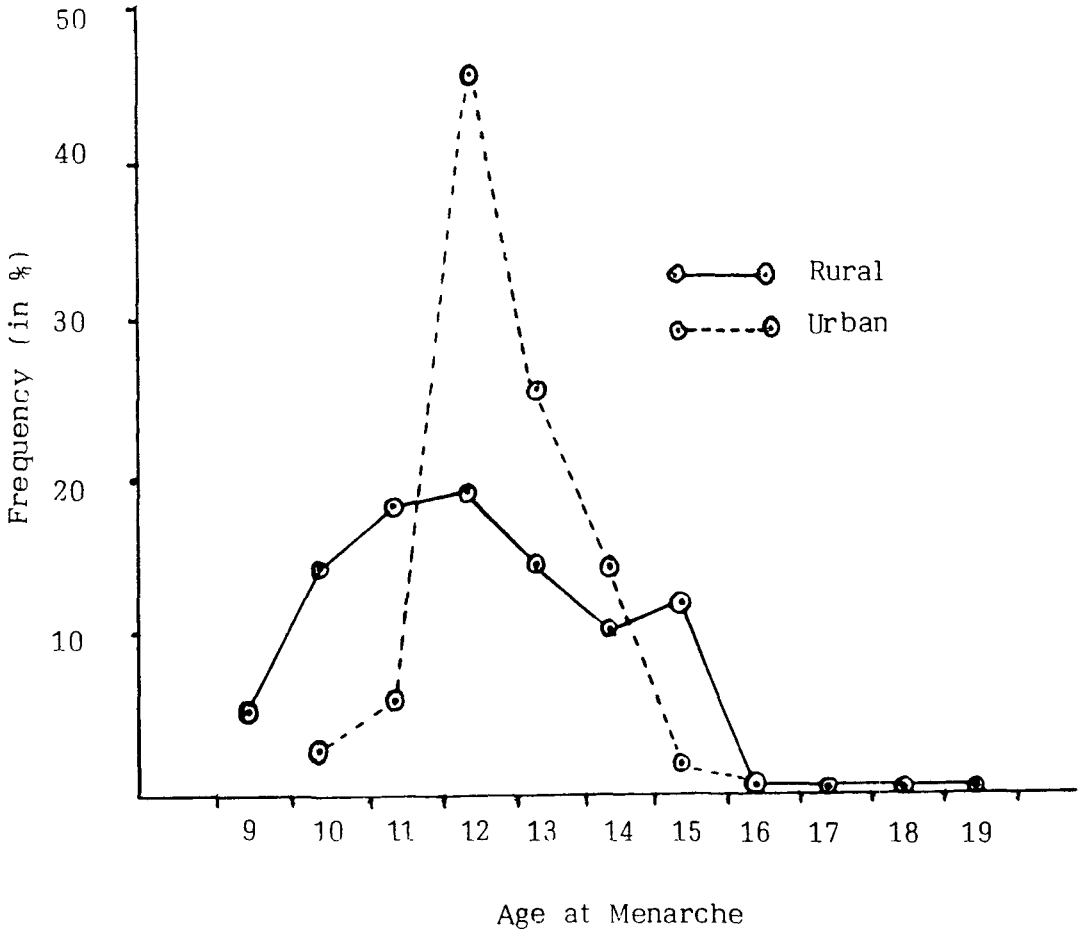


Fig.3.1 DISTRIBUTION OF WOMEN ACCORDING TO AGE AT MENARCHE

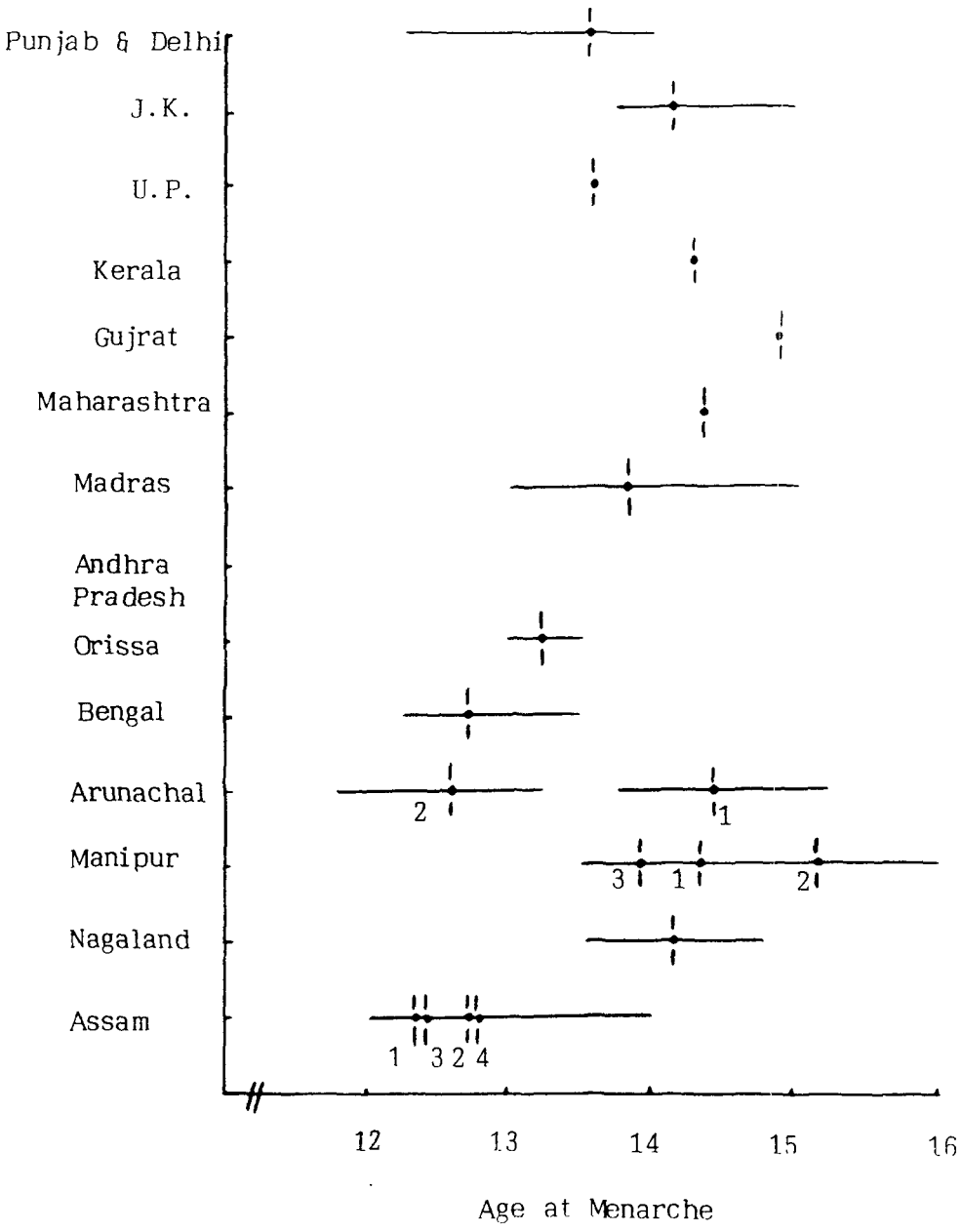


Fig.3.2 SHOWING RANGE OF MEAN AGE AT MENARCHE AND THE MEAN VALUE FROM DIFFERENT STUDIES (Table 4)

1974; 1986). Peller (1967) stated that "sexual maturation is an automatic endogenous process but environmental factors speed it up or delay it by months and years".

Many authors are of the view that the diversity within Indian population for cultural, social, geographical, nutritional in addition to genetical factors are also menifested in the attainment of menarche. Physiological reasons for onset of menarche have been studied by Balasuriya and Fernando (1988) and showed that the relaxed atmosphere influence the hypothalamus, thus triggering the onset of menarche earlier. The delayed onset of menarche in Mongoloid population, dwelling in higher altitude observed by many authors could well be due to low oxygen pressure of the atmoshpere, low mutritional intake, excessive physical activity psychological factor and over all low socio-econimic status (Greksa, 1990; Sharma, 1990; Malik and Hauspie, 1986).

Age at Menopause:

The distribution of women according to their age at menopause has been summarized in Table 3.5. It is evident that mean age at menopause in both the groups of muslim women is almost normal between 45-47 and nearly equal. The mean age being 46.21 $\pm$ .60 and 45.31 $\pm$ 0.56 in rural and urban respectively. In an exceptional case, a rural woman experienced menopause at a lower age of 35 years.

Investigation suggested that it may be due to extreme low economic, nutritional and psychological status. The range of age at menopause is larger by 3-4 years in rural group than urban. The highest frequency of 11.29 is observed at age 48 years in urban while the corresponding figure is 9.23 at age 42 and 45 in rural. Although the 't' value difference is not significant in the two groups (0.58), the menopause age is constantly lower in urban women as against the rural women more so between 39 to 47 and 52-55 years. Between age 47-51, the trend is reversed and frequency of menopause considerably higher in urban women and drops in rural group Fig.3.3. The two groups are pooled for the purpose of comparison.

The data on menopause in India is very scanty while in Assam it is almost lacking. The present Goalpara sample, therefore, could not be compared with any Assamese population. However, a comparison is made with the available data of Manipur, an adjoining state of Assam. In one of the similar study Chakravartti (1986) found that the average age at menopause in four population groups of Manipur ranges from 40.90 to 48.86 in Muslim and Kabui Nagas respectively. Fig. 3.4 shows that the present sample are in close conformity with Tangkhul Naga and Meitei of Manipur while Muslim and Kabui Naga stand apart. It is very difficult to draw any

TABLE 3.5: DISTRIBUTION OF WOMEN ACCORDING TO THE AGE AT MENOPAUSE IN GOALPARA DISTRICT

AGE AT MENOPAUSE IN YEARS	RURAL		URBAN	
	NO.	%	NO.	%
35	1	1.54	-	-
36	-	-	-	-
37	-	-	-	-
38	-	-	3	4.84
39	3	4.61	2	3.22
40	5	7.69	4	6.45
41	2	3.10	4	6.45
42	6	9.23	5	8.06
43	4	6.15	3	4.84
44	5	7.70	4	6.45
45	6	9.23	5	8.06
46	4	6.15	2	3.22
47	5	7.70	3	4.84
48	3	4.61	7	11.29
49	2	3.10	6	9.68
50	4	6.15	6	9.68
51	3	4.61	3	4.84
52	4	6.15	2	3.22
53	3	4.61	1	1.61
54	3	4.61	1	1.61
55	1	1.54	-	-
56	-	-	-	-
57	-	-	1	1.61
58	1	1.54	-	-
TOTAL	65	100.00	62	100.00
Mean age at Menopause	46.21 $\pm$ 0.60		45.81 $\pm$ 0.56	
Values of t = 0.58.	d.f. ∞		Non-significant.	

Fig. 3.3 DISTRIBUTION OF WOMEN ACCORDING TO AGE AT MENOPAUSE

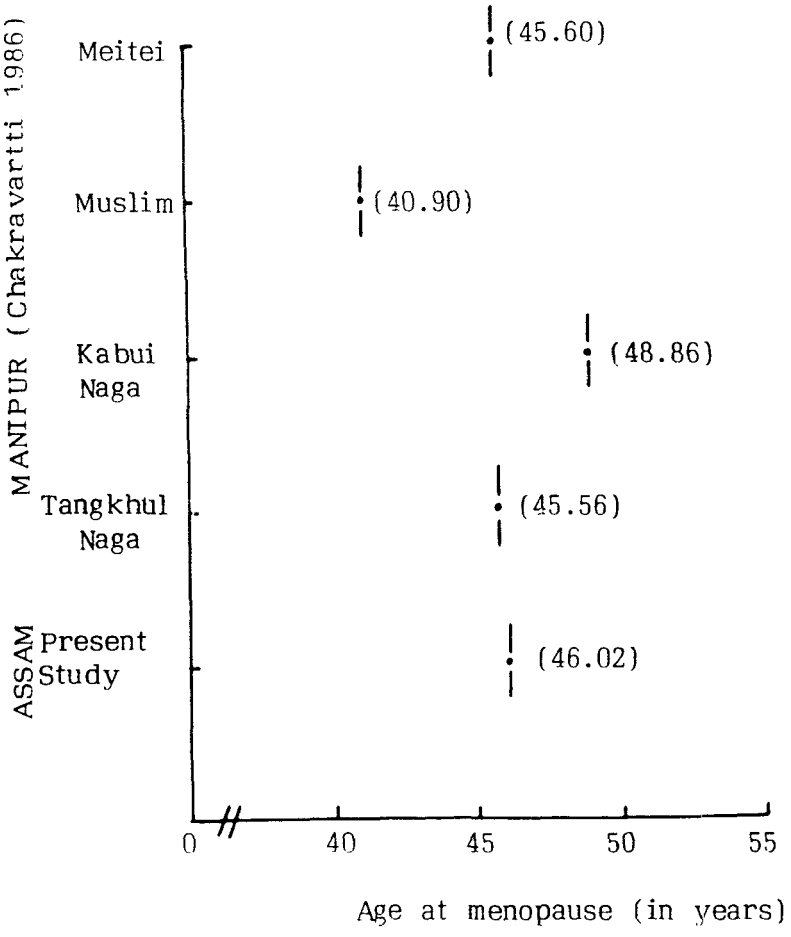


Fig.3.4 AVERAGE AGE AT MENOPAUSE IN DIFFERENT POPULATION GROUPS

conclusion with this limited data therefore it is kept for an open discussion.

The menopause also depends upon various factors as menarche. The time at which women reach menopause depends mainly on socio-economic factors and health culture. Reuban (1955) stated that better economic condition and good food delay the age of menopause. The present study shows an inconclusive result as the subjects under study comes from poor economic condition with poor hygine, lack of medical care etc. especially from rural area with higher age at menopause. It may be mentioned that it is very difficult to get accurate age at menopause from a women who is too old to recollect her exact age. Illiteracy is the another reason. This needs a furhter careful and thorough study. A study on various socio-economic factors which are of significant from the point of view of moral and psychic environment with reliable estimate of the age is also equally important in this connection and hence recommended to be taken into account.

Age at Marriage:

The distribution of women according to their age at marriage, their mean, S.E. and t values of the two groups of Muslim are summarized in Table 3.6. The range of age at marriage varies between 5 and 22 years in rural women and 7 and 29 in urban. It is estimated that about 15 percent of

TABLE 3.6: DISTRIBUTION OF WOMEN ACCORDING TO THE AGE AT MARRIAGE IN GOALPARA

AGE AT MARRIAGE (YEARS)	RURAL MUSLIM		URBAN MUSLIM	
	n	%	n	%
5	2	1.56	–	–
6	4	3.12	–	–
7	13	10.16	2	2.08
8	4	3.12	–	–
9	8	6.25	–	–
10	17	13.28	1	1.04
11	9	7.03	–	–
12	24	18.75	15	15.62
13	12	9.37	9	9.37
14	12	9.37	8	8.33
15	6	4.69	13	13.54
16	8	6.25	15	15.62
17	4	3.12	8	8.33
18	–	–	12	12.50
19	1	0.78	1	1.04
20	2	1.56	5	5.20
21	1	0.78	3	3.12
22	1	0.78	1	1.04
23	–	–	–	–
24	–	–	1	1.04
25	–	–	1	1.04
26	–	–	–	–
27	–	–	–	–
28	–	–	–	–
29	–	–	1	1.04
TOTAL	138	100.00	96	100.00
Mean age at Marriage		11.70 ± 0.30		15.64 ± 0.35

Values of t = 8.58, P < 0.001 Significant

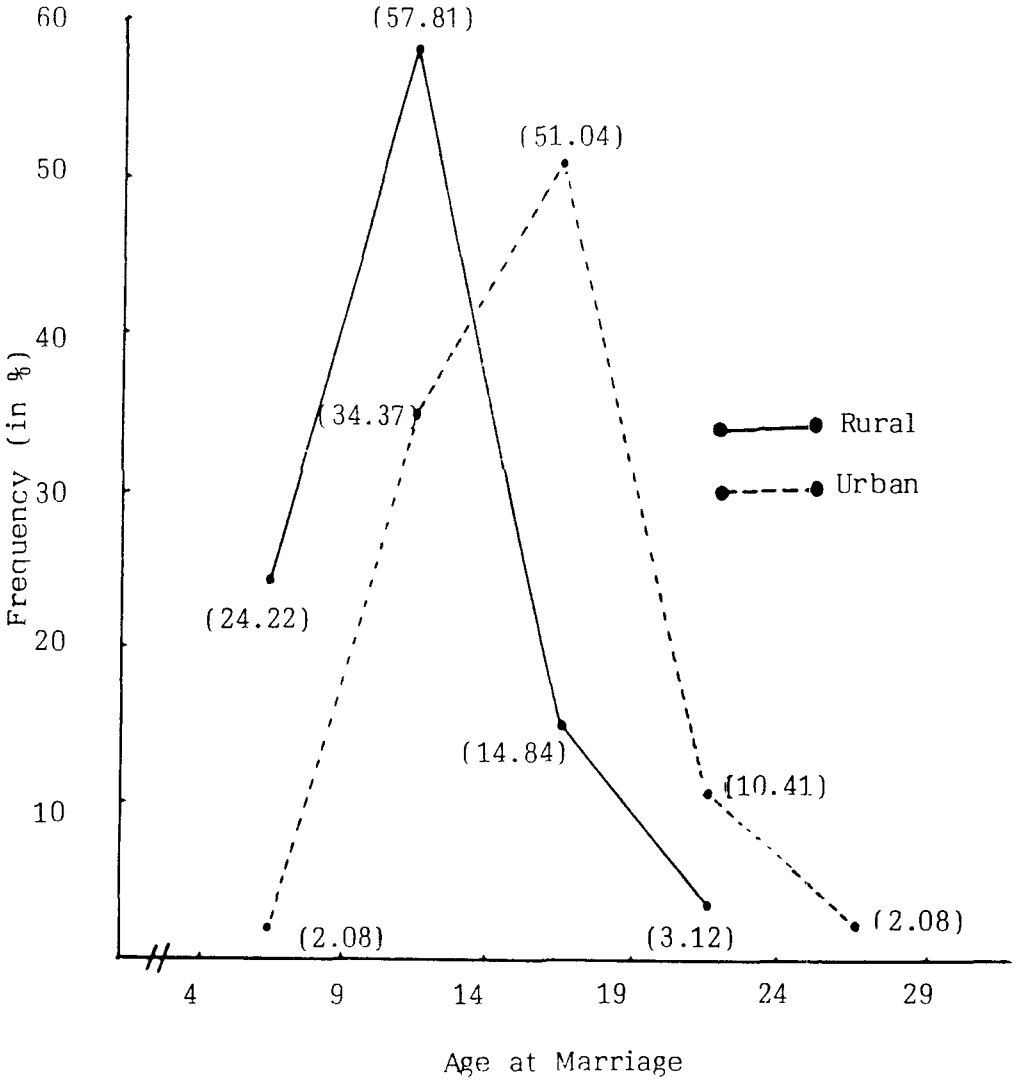


Fig.3.5 DISTRIBUTION OF WOMEN AT DIFFERENT AGE GROUPS ACCORDING TO AGE AT MARRIAGE

the women entered into marriage before menarcheal age in rural, which in far higher than 2.08 percent in urban. Results indicate that the rural women in general got married at their early ages (11.70 $\pm$ .30) as against urban women (15.64 $\pm$ .35). There appears to be a significant difference between the two groups as regards their age at marriage (t = 8.58, $P < .001$). Fig. 3.5 shows the frequency of marriages between different age groups among the two sample. It can readily be seen that 57.81% of marriage occur in the age group 10-14 in rural women, while the comparable high frequency of 51.04% in urban women is in the age group 15-19 years; the figure in the same age group is quite low in rural women i.e. 14.84%.

The present study has significant difference with the other studies (Das et al 1989). It has been found that mean age at marriage in two Muslim groups of Goalpara district is constantly lower (11.70 and 15.64) than either Assamese Muslim or Hindus (16.3 years in both cases) or Assamese Mongoloid (18.3 years).

Age at First Child:

The occurrence of women according to their age at the time of birth of the first child and the mean age of the two groups of muslim women are presented in Table 3.7. The range at the time of a first child varies between 10-28 and 12-32 years in rural and urban groups. There is a steady

decline in the number of women having first child beyond age 20, and the tendency is more prominent in rural women between 29-32 years where no case is reported having first issue, while in urban there seem to be some cases though very few in number. The mean age of mother of the first child being 15.90 $\pm$ 0.28 in rural and 17.78 $\pm$ 0.35 in urban.

Profiles of age of mothers at first child are quite evident from fig. 3.6, where it is generally found that due to early marriage in rural women a high frequency of women (about 35%) have their first child in age group 9-14 in contrast to 12.09% among urban. However, for age group 14-19, the trend is reversed in favour of urban women; about 69% of them have their first child in that age group. This frequncy is considerably higher than 52% in rural. For higher ages (> 24 groups). The corresponding figures are more or less similar in the two areas. High rates of rural women having their first child because of early marriage seems to have a direct bearing on high mortality discussed elsewhere in the present study.

The mean age of mother at the time of first child is again less than the other findings in three population groups of Assam (Das et al 1989). It is apparent that Muslims in the present study generally give birth of a first child at lower age as compared with other population groups. This is understood as Muslim women are found to marry earlier.

TABLE 3.7: DISTRIBUTION OF WOMEN ACCORDING TO THE AGE AT THE TIME OF FIRST CHILD IN GOALPARA MUSLIM

MOTHER AGE (YEARS)	RURAL MUSLIM		URBAN MUSLIM	
	n	%	n	%
10	1	0.79	–	–
11	2	1.59	–	–
12	10	7.94	1	1.09
13	15	11.90	3	3.30
14	16	12.70	7	7.70
15	22	17.46	11	12.09
16	17	13.49	13	14.29
17	14	11.11	11	12.09
18	10	7.94	16	17.58
19	2	1.59	12	13.19
20	6	4.76	3	3.30
21	4	3.17	3	3.30
22	2	1.59	5	5.49
23	2	1.59	2	2.20
24	–	–	–	–
25	1	0.79	1	1.09
26	–	–	–	–
27	–	–	1	1.09
28	2	1.59	–	–
29	–	–	–	–
30	–	–	1	1.09
31	–	–	–	–
32	–	–	1	1.09
TOTAL	126	100.00	91	100.00
Mean Age of Women	15.90 ± 0.28		17.78 ± 0.35	

Values of t = 4.18 P < 0.001 Significant

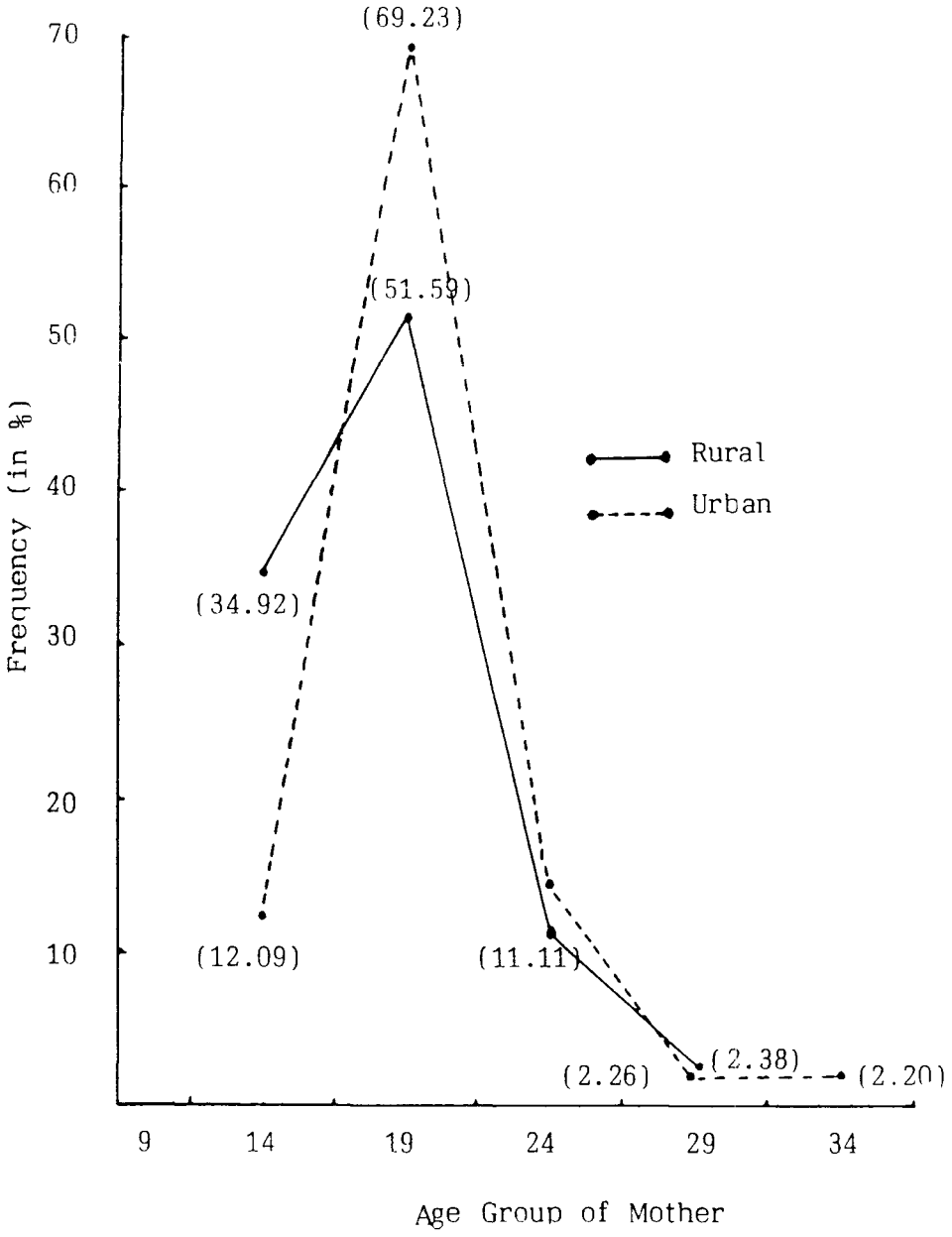


Fig.3.6 DISTRIBUTION OF WOMEN AT DIFFERENT AGE GROUPS ACCORDING TO THEIR AGE AT FIRST CHILD

Due to non availability of data the present sample could not be compared with other population groups of India.

FERTILITY PATTERN

Conception:

The distribution of women accroding to the age and number of conception is summarized in Table 3.8. The number of conception below 30 years of age ranges from 1-12 in rural and 1-8 in urban women. The range of conception in the next higher group vary from 1-14 in rural and 1-12 in urban. While in upper age group (>44 years) it is 3-15 and 1-12 in two groups respectively. It is evident from the table that rural women of age group > 44 years conceived not less than 3 times and a very high number of woman experienced 8 times of conceptions. Similarly in urban sample older women (> 44 years) always conceived more. The average conception of each of the three age groups (> 30, 30-44, and > 44) show higher figures 3.8, 8.2 and 9.9 in rural as against urban 2.9, 5.0 and 7.3 respectively. When the women of all the age groups are taken into consideration, rural woman as usual show higher mean value of conception (6.2) than urban (4.6). There is significant difference between three age groups as well as pooled means, barring women below 30 years of age (Table 3.9). Fig. 3.7 also depicts significant variation between the two groups of 30-44 years and above 44 years.

TABLE 3.8: DISTRIBUTION OF WOMEN BY AGE AND NUMBER OF CONCEPTION OF GOLAPARA

NO. OF CONCEP-TION	RURAL AGE GROUP IN YEARS				URBAN AGE GRUOP IN YEARS			
	< 30	30-44	> 44	TOTAL	< 30	30-44	> 44	TOTAL
1	11 (16.7)	1 (2.9)	-	12 (9.5)	10 (28.5)	2 (5.1)	-	12 (13.2)
2	15 (22.7)	-	-	15 (11.9)	10 (28.6)	6 (15.4)	1 (5.9)	17 (18.7)
3	8 (12.1)	1 (2.9)	1 (4.0)	10 (7.9)	4 (11.4)	6 (15.4)	-	10 (11.0)
4	10 (15.6)	3 (8.6)	1 (4.0)	14 (11.1)	3 (8.6)	6 (15.4)	1 (5.9)	10 (11.0)
5	5 (7.6)	2 (5.7)	-	7 (5.6)	4 (11.4)	4 (10.3)	4 (23.5)	12 (13.2)
6	7 (10.6)	4 (11.4)	1 (4.0)	12 (9.5)	2 (5.7)	5 (12.8)	2 (11.8)	9 (9.9)
7	7 (10.6)	5 (14.3)	1 (4.0)	13 (10.3)	-	4 (10.3)	2 (11.8)	6 (6.6)
8	1 (1.5)	4 (11.4)	5 (20.0)	10 (7.9)	2 (5.7)	1 (2.6)	1 (5.9)	4 (4.4)
9	-	1 (2.9)	1 (4.0)	1 (1.6)	-	2 (5.1)	-	2 (2.2)
10	-	3 (8.6)	4 (16.0)	7 (5.5)	-	-	3 (17.6)	3 (3.3)
11	1 (1.5)	6 (17.1)	4 (16.0)	11 (8.7)	-	2 (5.1)	2 (11.8)	4 (4.4)
12	1 (1.5)	2 (5.7)	1 (4.0)	4 (3.2)	-	1 (2.6)	1 (5.9)	2 (2.2)
13	-	1 (2.9)	3 (12.0)	4 (3.2)	-	-	-	-
14	-	2 (5.7)	2 (8.0)	4 (3.2)	-	-	-	-
15	-	-	1 (4.0)	1 (0.7)	-	-	-	-
TOTAL NO. OF WOMEN	66	35	25	126	35	39	17	91
TOTAL NO. CONCEPTION	252	287	247	786	102	194	124	420
MEAN CONCEPTION	3.8	8.2	9.9	6.2	2.9	5.0	7.3	4.6

TABLE 3.9: VALUES OF BETWEEN RURAL AND URBAN WOMEN AT DIFFERENT AGE GROUPS.

AGE GROUPS	t VALUE	INFERENCE
< 30	1.88	Non Significant
30-44	4.60	Significant
> 44	2.77	Significant
Pooled	3.33	Significant

d.f α at 5% level.

TABLE 3.10: DISTRIBUTION OF MEAN CONCEPTION OF DIFFERENT POPULATION GROUPS

POPULATION	MEAN CONCEPTION	SOURCE
GOALPARA (ASSAM)		
Rural	6.20	Present Study
Urban	4.60	Present Study
ASSAM		
Hindus	5.10	Das et al 1989
Muslim	4.70	Das et al 1989
Mongoloids	5.30	Das et al 1989
MANIPUR		
Meitei	4.65	Chakravartti (1986)
Kabui Naga	4.92	Chakravartti (1986)
Tangkhul Naga	4.56	Chakravartti (1986)
Muslim	5.00	Chakravartti (1986)

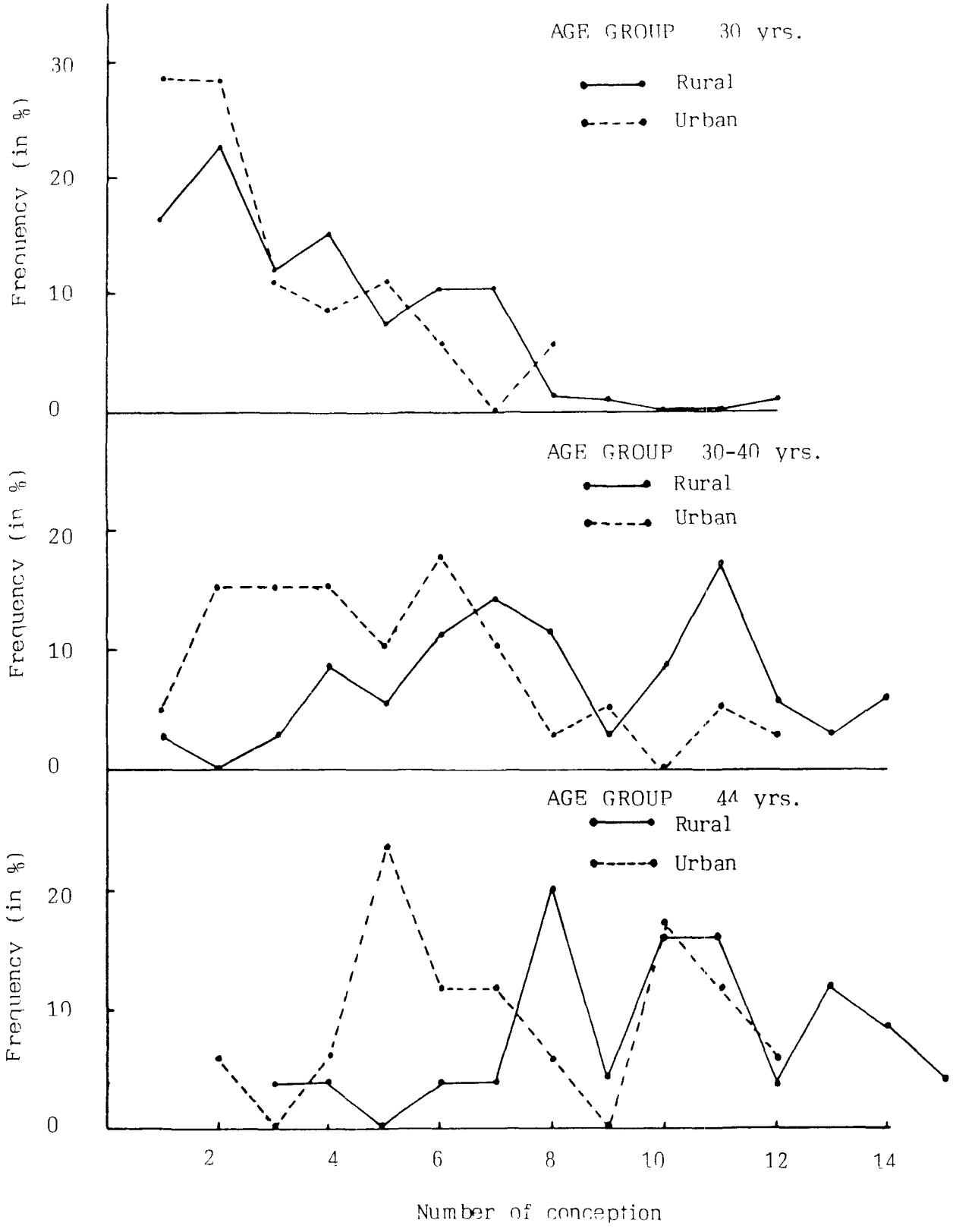


Fig.3.7 DISTRIBUTION OF WOMEN BY AGE AND NUMBER OF CONCEPTION

The highest mean value of conception (6.2) is found among the rural muslim women of the present study. A comparison among different population shown in Table 3.10. while urban muslim (mean 4.6) shows close association with Assamese Muslim (mean 4.7) the Muslim of Manipur (mean 5.0) stands in between the present samples.

Live Birth:

The distribution of women according to age and number of live births are presented in Table 3.11. That the mean age at live births of women in all the three age groups in rural are higher than urban women is quite clear. The mean live births being 3.3, 7.2, 8.5 and 2.6, 4.1, 7.1 respectively. t values bear no significant differences betweenn the two groups at lower and higher age groups (<30 and > 44 years). While at 30-44 age group the distribution of women are significantly different from each other (t = 5.28) (Table 3.12). Fig.3.8 depicts that below 30 years of age group the distribution is more or less similar while at age group > 44 years shows a clear picture of artificial measure adopted by the urban women to minimize their live births. On the contrary the rural women go on reproducing childern till their reproductive age end, therefore, increased number of live births is resulted with the advancing age. In the middle aged urban women less number of live births are more evident than rural. The live births

TABLE 3.11: DISTRIBUTION OF WOMEN BY AGE AND NUMBER OF LIVE BIRTHS OF GOALPARA

NO. OF LIVE BIRTH	RURAL AGE GROUP IN YEARS				URBAN AGE GRUOP IN YEARS			
	< 30	30-44	> 44	TOTAL	< 30	30-44	> 44	TOTAL
1	13 (19.7)	1 (2.9)	-	14 (11.1)	11 (31.4)	2 (5.1)	-	13 (14.3)
2	16 (24.2)	-	-	16 (12.7)	10 (28.6)	9 (23.1)	1 (5.9)	20 (22.0)
3	12 (18.2)	4 (11.4)	1 (4.0)	17 (13.5)	4 (11.4)	10 (25.6)	-	14 (15.4)
4	10 (15.15)	-	2 (8.0)	12 (9.5)	6 (17.1)	6 (15.4)	1 (5.9)	13 (14.3)
5	4 (6.1)	4 (11.4)	1 (4.0)	9 (7.1)	3 (8.6)	2 (5.1)	4 (23.5)	9 (9.9)
6	7 (10.6)	3 (8.6)	-	10 (7.9)	-	4 (10.3)	2 (11.8)	6 (6.6)
7	2 (3.0)	7 (20.0)	3 (12.0)	12 (9.5)	-	1 (2.6)	3 (17.6)	4 (4.4)
8	-	6 (17.1)	6 (24.0)	12 (9.5)	1 (2.9)	2 (5.1)	-	3 (3.3)
9	2 (3.0)	2 (5.7)	4 (16.0)	8 (6.3)	-	2 (5.1)	2 (11.8)	4 (4.4)
10	-	4 (11.4)	4 (16.0)	8 (6.3)	-	1 (2.6)	2 (11.8)	3 (3.3)
11	-	3 (8.6)	-	3 (2.4)	-	-	1 (5.9)	1 (1.1)
12	-	-	1 (4.0)	1 (0.87)	-	-	1 (5.9)	1 (1.1)
13	-	-	3 (12.0)	3 (2.4)	-	-	-	-
14	-	1 (2.9)	1 (0.87)	-	-	-	-	-
TOTAL NO. OF WOMEN	66	35	25	126	35	39	17	91
TOTAL NO. OF LIVE BIRTH	215	255	212	684	90	159	120	369
MEAN LIVE BIRTH	3.3	7.2	8.5	5.3	2.6	4.1	7.3	4.05

TABLE 3.12 : VALUES OF T BETWEEN RURAL AND URBAN WOMAN AND DIFFERENT AGE GROUPS.

AGE GROUPS	t VALUE	INFERENCE
30	1.88	Non-significant
30-44	5.28	Significant
44	1.32	Non-siginificant
Pooled	2.99	Significant

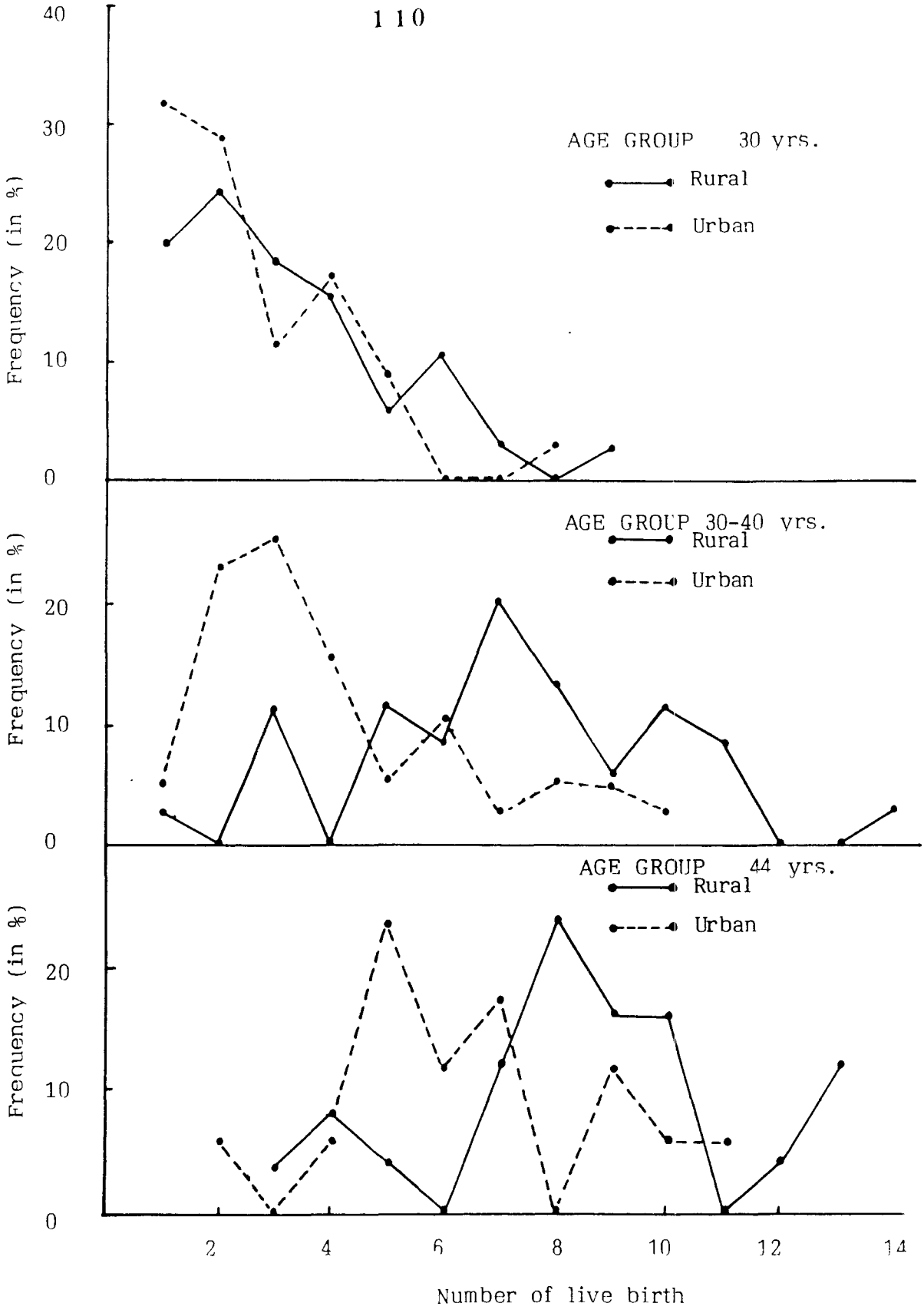


Fig.3.8 DISTRIBUTION OF WOMEN BY AGE AND NUMBER OF LIVE BIRTH.

between 5 and 6 are more or less similar in bo-th the groups, while tendency towards more live births is evident in rural. In urban however, it is reversed.

The age wise fertility behaviour among the two groups of Muslims are summarized in Table 3.13. It is seen from the table that higher incidence of pregnancy occurs at 20-29 years of age group in rural women, while it is 30-39 years of age group in urban, indicating that rural women become pregnant at the very early age in comparison to urban women. As regards live births, the age group 30-39 show highest incidence (94.31%) in rural, while 100 percent live births is evident in the urban muslim at 50-59 years of age group, not withstanding the small sample. The still births occur more frequently at the lower age group (10-19) in rural women (20.83%) while no still birth is reported in urban sample and highest frequency of 6.32% is observed between age group 20-29 in urban. A reversed situation is however, noticed at 10-19 years as regards miscarriage/abortion in rural and urban women. When women of all the age groups are taken into consideration it is found that live births in both the groups are more or less similar, while living children are less in rural indicating high mortality of 24.55% in contrast to urban (7.14%). Miscarriage/abortions considerably high (8.57) among the urban than rural (6.49) indicates that urban women adopt artificial measure to minimize their family size.

TABLE 3.13: AGE-WISE FERTILITY BEHAVIOUR AMONG THE TWO GROUPS OF MUSLIM IN GOALPARA

GROUPS	AGE GROUP	NO.OF WOMEN	TOTAL CONCEP-TION	LIVE BIRTHS	STILL BIRTHS	MISCA-RIAGE	STILL ALIVE	TOTAL DEATH
	10-19	12	24	19 (79.12)	5 (20.83)	-	17 (70.83)	2 (8.33)
			2.0	1.58	0.42		1.42	0.17
	20-29	54	239	205 (85.77)	14 (5.86)	20 (8.37)	162 (67.78)	43 (17.99)
			4.43	3.80	0.26	0.37	3.0	0.80
RURAL	30-39	21	123	116 (94.31)	4 (3.25)	3 (2.44)	83 (67.48)	33 (26.83)
			5.86	5.52	0.19	0.14	3.95	1.57
	40-49	21	223	191 (85.65)	8 (3.59)	24 (10.76)	145 (65.02)	46 (20.63)
			10.62	9.10	0.38	1.14	6.90	2.19
	50-59	12	115	104 (90.43)	9 (7.83)	2 (1.74)	63 (54.78)	41 (35.65)
			9.58	8.67	0.75	0.17	3.25	3.41
	60 +	6	62	49 (79.03)	11 (17.74)	2 (3.23)	21 (33.87)	28 (45.16)
			10.33	8.177	1.83	0.33	3.5	4.67
	TOTAL	126	786	684 (87.02)	51 (6.49)	51 (6.49)	491 (62.47)	193 (24.55)
			6.24	5.43	0.40	0.40	3.90	1.53
	10-19	5	7	6 (85.11)	-	1 (14.29)	6 (85.71)	-
			1.4	1.2		0.20	1.20	
	20-29	30	95	84 (88.52)	6 (6.32)	5 (5.25)	79 (83.16)	5 (5.26)
			3.17	2.8	0.20	0.17	2.63	0.17
URBAN	30-39	31	128	104 (81.25)	6 (4.69)	18 (14.06)	91 (71.09)	13 (10.16)
			4.13	3.35	0.19	0.58	2.93	0.42
	40-49	15	109	96 (88.07)	3 (2.75)	10 (9.17)	88 (80.73)	8 (7.33)
			7.27	6.40	0.20	0.67	5.87	0.53
	50-59	6	50	50 (100.0)	-	-	50 (100.0)	-
			8.33	8.33			8.33	
	60 +	4	31	29 (93.55)	-	2 (6.45)	25 (80.64)	4 (12.9)
			7.75	7.25		0.5	6.25	1.00
	TOTAL	91	420	369 (87.86)	15 (3.57)	36 (8.57)	339 (80.71)	30 (7.14)
			4.61	4.05	0.16	0.40	3.72	0.33

TABLE 3.14: RATES OF FERTILITY, SURVIVAL AND TOTAL CHILD LOSS IN THREE DIFFERENT AGE GROUPS AMONG TWO MUSLIM GROUP IN GOALPARA

POPULATION	AGE GROUP	NO. OF WOMEN	FERTILITY RATE	SURVIVAL RATE	TOTAL CHILD LOSS
RURAL	10-29	66	3.98	2.71	1.27
	30-49	42	8.24	5.43	2.81
	50 +	18	9.83	8.50	5.17
	TOTAL	126	6.24	3.90	2.34
URBAN	10-29	35	2.91	2.43	0.49
	30-49	46	5.15	3.89	1.26
	50 +	10	8.10	7.50	0.60
	TOTAL	91	4.61	3.72	0.89

Table 3.14 presents the rate of fertility, survival and total loss of children in the three age groups of two muslim populations. Rate of fertility, survival and total child loss are more among the rural than urban. It is also clear that the fertility rate is increased with the increase of age group in both the groups. The same trend is prevalent in the case of survival rate and total child loss except in the case of total child loss at upper age group (50 +) in urban group. A significantly low value of death rate among the urban may be due to exposure to good medical care, immunization and proper care and education facilities.

From the foregoing discussion it is apparent that the early marriage in rural areas exerts a greater effect on fertility pattern. The marriage at younger age provides an enlarge reproductive span and hence increased fecundity. More or less similar conclusions were drawn by Reddy and Rohini (1989) and subsequently confirmed by Shami et al (1990). It is usually found that educated women tend to marry late when compared with rural folks. The age at marriage and education show an iverse relationship with fertility measured in terms of live births. The people of rural concentration are mostly illiterate hence show more conception, thereby increased live births. Early age at marriage is directly correlated with the total fertility in a population. It is found that fertility resulting from too

many pregancies may adversely affects the mothers health; ill health of the mother may reduce her capacity to produce viable offspring. These observations confirmed the findings of Bharati and Basu (1990).

The rural Muslim of the present study show higher reproductive wastage in the form of still birth and miscarriage. It is further aggravated because of lack in proper medical care during pre and post-natal period in rural women. Rarely and almost only in serious cases, delivary is preferred in the hospital. It is more probable that several malformed foetus possibly due to chnomosomal aberration are aborted out spontaneously at the early stage of development. The high frequency of abortion (8.57%) found in urban women on the other hand, however, is not due to lack of medical care, but because of adoption of artificial abortion methods and contraception to limit the rate of fertility and minimize the family size.

Lack of advance medicine and public health practices in the interior rural areas cause high mortality (24.55%) as against urban (7.14%). Much immunization programme have been broadly extended to the urban areas in comparison to the rural. This, in addition to the introduction of antibiotic technique among the people of urban may seem to be a partial answer to the low mortality rate i.e. 0.33 in comparison to 1.53 in rural areas.

The women with early puberty are more fecund than women with delayed puberty. This according to Udry and Cliquet (1982) and Urdry (1988) may increase the exposure to the risk of pregnancy.

Martorell et al (1981) indicated the existence of a relationship between marital status with parity, offspring mortality and number of surviving children. Shorter women tended to have greater parities but fewer surviving children. It is also observed that, fertility is higher in anaemic women than non-anaemic ones, however in case of mortality analogous results are obtained (Bharati and Basu 1990). The present study although, not deals with the above parameters, the probable cause of fertility behaviour and mortality due to above reasons may not be ruled out.

SUMMARY

SUMMARY

1. Observations on the genetic markers, ABO blood group, Taste sensitivity (PTC) and Reproductive behaviour cum Fertility pattern among the two Muslim groups of rural and urban origin of the district Goalpara of Assam were made during the months of April and may 1990 and October and November 1990. A great care was exercised in collection of data and remotest villages were selected for rural samples.

2. *Prescribed field methods were used for ABO blood group* determination. The taste sensitivity was examined by standard threshold method. Reproductive behaviour and Fertility pattern was based on prescribed schedule/questionnaire in the field from evermarried women only. A complete reproductive history was compiled by retrospective recall method. Both the sexes were subjected to the ABO and PTC taste ability and comprised of more than 100 samples for each of the parameters.

ABO Blood Group: types, *frequencies and comparisons*

3. In respect of ABO blood groups examined there exists no statistical differences between the two sexes of either of the groups. Moreover, the groups also do not show significant difference (X^2 = 1.23), hence are pooled for the purpose of comparisons.

4. The phenotype frequency is B>O>A>AB while their allele frequency is r>q>P. The genotype frequencies however, show a different order ii > I^{Bi} ii^{B} > $L^{A}i$ > I^{A} I^{B} > I^{B} i^{B} >I^{A} I^{A}, the same has been highlighted in Penrose's equilateral triangles.

5. An extensive comparative studies were undertaken. Out of 9 Muslim samples of 6 districts of Assam, 6 samples namely Goalpara I and II, Kamrup II, Darrang, Sibsagar and Dibrugarh II present an order of ABO allele frequencies as r>q>p while other three samples, Kamrup I, Nowgong and Dibrugarh I show r>p>q.

The breakup of ABO blood group phenotypic frequencies of the above sets of observation is O>A> AB>B (Nowgong), O>A>B>AB (Kamrup I and Dibrugarh I), B>O>A>AB (Goalpara II, present study) andthe rest five samples comes under O>B>A>AB.

6. The present sample of Goalpara II is compared with other Muslim groups of Assam. The Chi-square values show significant statistical differences except for Darrang and Dibrugarh II.

7. In yet another comparison with the Muslims of other states of India, the allelic and phenotypic frequencies are reported. Of the 20 samples 15 samples have the allelic order r>q>p and is in conformity with the present sample. While of the 18 samples analysed for phenotypic frequencies most of the samples are of the order B>O>A>AB which again agrees with

our present study. A very rare allelic and phenotypic frequency order among the Sunnis of Hariparigam p>r>q and A>AB>B>O observed stands apart.

8. When present sample is compared with other caste Hindus and Tribal groups of Assam significant differences are observed except with high caste (X^2 = 7.52, 0.10>P>0.05).

PTC taste Threshold, frequencies and comparisons

9. Taste sensitivity of two Muslim groups under study show T and t allele distribution 0.346, 0.654; 0.383, 0.617 and 0.371, 0.629 in rural, urban and combined respectively.

10. The mean taste serial number are 7.26 ± 0.21 and 5.69 ± 0.13. No significant variation between the samples are observed (X^2 = 1.16, df = 1 0.30>p>0.20.

11. Sex-wise distribution of PTC taste sensitivity suggests that:

(a) Females are more sensitive (62.29%) to PTC than male (55.77).

(b) Females are on the average can taste higher dilution of PTC. Mean TSN being 7.38 ± 0.24 and 5.81 ± 0.20 as against males 6.93 ± 0.45 and 5.54 ± 0.22 in rural and urban in that order.

(c) Whereas chi-square value show no statistical difference between the sexes as also among two groups, t values present significant differences between rural Vs urban males

(t=2.95), rural female vs urban females (t = 4.98) and rural Vs urban (t=6.1).

12. There is an indication of decreasing taste sensitivity to PTC with increasing age in all the samples of the present study.

13. Observations on Goalpara I and Goalpara II (present study) show contrary results. Figures for tasters, non tasters and allelic frequencies in these two samples are 89.5, 60.39; 10.5, 39.61; and 0.676 - 0.371, 0.324 - 0.624 respectively. Chi-square value shows highly significant difference between the groups (X^2 = 33.04; P<0.001). Other districts viz. Kamrup, Darrang, Nowgong, Sibsagar and Dibrugarh show significant differences when they are compared with present sample.

14. District-wise variation in mean taste threshold of Assam ranges from 6.06 $\pm$ 0.34 to 8.56 $\pm$ 0.14. The present sample with 6.18 $\pm$ 0.13 falls within this range.

15. High caste, low caste and Muslims were compared and intergroup variability are found to statistically significant.

16. Generally, people with Mongoloid affiliation are more tasters than caucasoid. It is reported that the range of non tasters in Mongoloid is 2.18 to 21.14 as against caucasoid

11.3-42.6, therefore the present sample with 39.61 can well be placed with caucasoid.

Reproductive behaviour and fertility pattern:

17. The parameters: Menarche, Menopause, age at marriage, age at first child, number of conceptions, live births, still births, miscarriage/abortion and total child loss etc. were observed in great detail.

18. Onset of menarcheal age among rural and urban women are more or less equal. The mean menarcheal age being 12.27 ± 0.17 and 12.53 ± 0.11 respectively; t value shows no significant difference between the groups, thus pooled comparison.

19. Menarcheal data is compared with other groups of Assam. The t value show no significant differences with caste Hindus. viz Ahom, Brahmin, Kayastha and Kalita. Nonetheless it shows significant difference with other two muslim samples, Hindus and Mongoloid groups.

20. The mean age at menarche of women of Assam including present study agrees with the mean of Bengal women and singphoos of Arunachal. Population with Mongoloid affiliation show higher value of mean ie. > 14 years. Though disputed Manipuri Muslims shows a very early menarcheal age of 10.73 years (Chakravartti, 1986).

21. Observations on menopause shows the mean age 46.21 ±

0.60 and 45.81 ± 0.56 in rural and urban respectively. The range being 35 though (an exceptional case) to 58 years in rural and 38-57 years in urban.

22. Highest frequency of women (11.29%) are observed at 48 years of age in urban. The corresponding figure of 9.23% is observed at 42 and 45 years in rural.

23. The age of menopause is found to be constantly lower in urban women. This is more conspicuous between age groups 39-47 and 52-55. However for age group 47-51, the trend is reversed and frequency of menopause is higher in urban.

24. Present pooled sample on menopause (Mean 46.02 yrs.) is in close conformity with Tankhul Nagas (mean 45.56 yrs) and meitei (45.60), while Muslim (40.90) and Kabui Nagas (48.86) of Manipur Stand apart when compared.

25. The range of age at marriage varied between 5 and 22 years in rural and 7-29 years in urban women. About 15% of the women of rural areas entered into marriage before their menarchal age, a figure which is much higher than urban (2.08).

26. The mean age at marriage estimated to be 11.70 ± 0.30 in rural as against 15.64 ± 0.35 in urban. There is a significant difference between the two groups (t = 8.58).

27. Rural women marry much earlier than urban women. About 58% marriages were performed in the age bracket 10-14 years in rural, where as 51% marriages in urban are of age group 15-19 years. The figures in the same age group are far too less in rural.

28. The mean age of mother at the time of birth of a first child of the two groups is 15.90 $\pm$ 0.28 and 17.78 $\pm$ 0.35 and the range being 10-28 and 12-32 years in rural and urban respectively.

29. 34.93% of women in rural have their first child at age group 9-14 years in contrast to 12.09% in urban. This trend is reversed at age group 14-19 in favour of urban (69.23%) than rural (51.59%).

30. The average conception for each of the three age groups (<30 yrs, 30-44 yrs and > 44 yrs) is constantly higher in rural than urban (3.8, 2.9; 8.2, 5.0; and 9.9, 7.5). Rural Women have higher frequency of conception (6.2) than urban (4.6). There is a significant differences in three age groups as well as pooled means except women below 30 years.

31. The mean live births are more frequently observed in women of rural origin, the figures, 3.3, 7.2 and 8.5 are higher than 2.6, 4.1 and 7.1 of urban t values show no significant differences between two groups at <30 and >44

years of age groups. The values being 1.88 and 1.32 respectively. However, at age group 30-44 statistical difference is observed (t = 5.28), pooled values of the two groups also show significant difference (t = 2.99)

32. Fertility behaviour suggest highest frequency of pregnancy at age group 20-29 in rural while it is 30-39 years in urban.

33. A reasonably high frequency of still births is 20.83% occurred at lower age group of 10-19 in rural while corresponding age group in urban recorded no still birth. However, miscarriage or abortion in the same age group are more common among urban, attributable to the tendency of having a small family. 34. The total live births are more or less equal (87.0-2% and 87.86%) in both rural and urban groups of muslims. Nevertheless living children are less in rural (62.47%) as against urban (80.71%), indicating higher mortality of the order of 24.53% in rural than urban (7.14%).

35. Although the total child loss at upper age group (50 +) in urban population declines, the rate of fertility, survivors and net child loss increase with the increase of mothers age in both the groups.

36. Each chapter is supported by various types of figures and facts and is concluded by giving possible reasons to explain various aspects during the course of observation.

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